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REVIEWS

Stresses in Framed Structures and Girders.

Reviewed by A. W. CARPENTER,* M. Am. Soc. C. E.

FRAMED STRUCTURES AND GIRDERS, THEORY AND PRACTICE.—Vol. I.: Stresses, Part I. By Edgar Marburg, C. E., Sc. D.; Professor of Civil Engineering, University of Pennsylvania. New York and London: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 540; many illustrations in text. $4, net.

The author's preface describes the scope of the work as follows:

> This work has been planned to appear in three volumes. The present volume is devoted mainly to the derivation of the fundamental principles of statics, the determination of shears and bending moments in beams and the analysis of roof and bridge trusses resting on two supports. The second volume will contain an elementary treatment of continuous girders, cantilevers, suspension, arch and movable bridges, and will also deal briefly with secondary stresses and the analysis of trusses with redundant members. The third volume will be devoted to the subjects of general design, details of construction, and erection.

The author states that "While the work is designed to serve primarily as a text-book, it is hoped that it will also be found useful as a reference book." Vol. I. certainly should be eminently successful for both purposes. It is apparently the most complete and modern book yet published on stresses in ordinary roof and bridge trusses. While much of the material presented is necessarily a duplication of that given in recognized standard works (although generally presented here in a distinctive manner), considerable new matter is given in this book and more matter altogether than can be found elsewhere within the writer's knowledge. The arrangement is excellent, the treatment is remarkably clear and in keeping with present-day practice. The work is scholarly yet eminently practical.

The scope of the work in general has been outlined in the opening quotation from the author's preface. More particularly, it covers the following:

Definitions of the elastic properties of materials and other fundamentals and general information on the application of the principles of statics to the determination of stresses; a considerable review of the principles of the equilibrium of forces and determination of reactions, giving the usual graphic demonstrations; a very complete exposition of shear and bending moments in simple beams, especially for wheel loads, considering external forces only; demonstrations of the general methods of stress analysis of framed structures, by moments, shears, coefficients and graphics; the analysis of stresses in usual types of roof trusses, the three-hinged arch and in bridge trusses with horizontal and inclined chords, both with and without subpanels, for all the usual forms of live loads as well as dead load; a historical sketch of the development of truss construction, with description of truss types, materials and considerations of modern design; demonstration of the graphic methods for determination of wheel-load stresses and method of influence lines; the analysis of stresses in skewed trusses and trusses on curves, in lateral (including portal) bracing and in railway viaduct towers; demonstration of methods of determining the deflection of trusses and of producing camber, including Williott's graphic method.

The arrangement of the work as regards the component subjects seems excellent, except possibly in the location of the chapter on "Modern Bridge Trusses and Their Development," which would seem very badly placed, although that is not a matter of great consequence. The text seems to be unusually clear and easy to follow. The diagrams are well made and arranged so as to be quickly comprehended and connected with the text. The denotation of diagrams and formulas is simple and consistent, although it is to be deplored that a standard denotation cannot be established and followed in works on this and allied subjects. Provision is made for the ready location of references to preceding or succeeding articles and there is a good index. The print is excellent, on good paper, and the book is substantially bound in dark blue cloth.

The book is not free from errors, but these do not appear to be at all frequent. Some of the errors noted will be mentioned hereinafter. Some of the unusual and characteristic features of the book are the following: Cooper's Class E-60 wheel loading and the American Railway Engineering Association Specifications for Steel Railway Bridges are used as a working basis, many examples of stresses in trusses being solved for this loading and the requirements of the American Railway Engineering Association specifications for various forms of loading and combinations of stresses being quoted and explained. Two copies of a moment table for Cooper's E-60 loading, on detached sheets, accompany each volume; the table is in the convenient form commonly used in practice and will be found useful to any practicing designer. The scheme of analysis of bridge trusses is to treat the three classes of trusses (1) those with horizontal chords, (2) those with inclined chords, (3) those with sub-panels—separately and for the various classes of loading successively in each case, the loadings so considered being (1) dead load, (2) uniform live load by conventional method, (3) concentrated live load, (4) uniform live load by exact method. Roof trusses are analyzed graphically but the analysis of stresses for bridge trusses is mainly analytical and in good accord with practice. Graphical methods are shown for cases to which they are most applicable but in general the graphical method for bridge trusses is confined to a special chapter which treats fully of live-load stresses by graphic methods and influence lines. Convenient methods of condensing and tabulating the operations for a slide-rule computation of stresses are given.

Other features of the work may be mentioned and some criticism stated as follows:

The definitions of the elastic properties of materials are especially good, the distinction between stress and strain being made clear and variations in the laws of elasticity being recognized in the statement that these laws are "approximately true." The so-called "factor-of-safety" is called "misleading because the elastic limit rather than the ultimate strength indicates the safe limit of strength." In stating that the distinguishing signs for tensile and compressive stress and strain are + and —, respectively, it might well have been stated that practice varies in this respect.

In the determination of maximum moments and shears by analytical methods differential calculus is resorted to.

A criterion for the stability of trusses and the determination of redundant members in trusses, which seems to be new and valuable, is given. This is in the shape of a formula giving the number of members necessary for a truss with a given number of joints. If the number in a given truss is less than that required by the formula, the truss is not stable; if more, there are redundant members.

In the chapter on roof trusses, trussed purlins are shown and their use mentioned, although their use is practically obsolete. Formulas for the weight of roof trusses are omitted, on the very good grounds that there are too many variables to make a reliable formula possible, data on the usual range of weight of trusses per square foot of horizontal projection of roof areas being given. The article on wind pressure seems to summarize about all the information available on this important subject, covering the ground of other treatises similar to this and with added information. The usual formulas for wind pressures normal to inclined surfaces are given. Recent experiments showing the true action of wind to be different from that usually assumed, especially in effects of suction, are quoted. The scale of these experiments the author thinks too small to give results applicable to conditions in practice. The inadequacy of existing knowledge on wind pressure on structures is pointed out, together with the futility of refinement in the computation of wind stresses. No mention is made of floor loads nor of traveling crane loads, which might be added for completeness. There is an excellent article on the combination of wind and snow loads, advocating the reduction of either the snow or the wind load to one-half the usual specified amounts in combination with the other. It would be illuminating if some one would analyze a number of representative mill buildings for the wind pressure they could withstand. The reviewer thinks the results would be found interesting if not startling.

An exceptionally good and practical analysis of the wind stresses in trusses supported on columns is given. This considers the case of columns fixed as well as hinged at bases. The analysis is based on the assumption that vertical loads produce no stress in the knee braces, which assumption cannot be true and some proof that it will not involve serious errors would seem desirable.

The theory of counters for roof and bridge trusses and the effects of initial stresses in the same are very fully explained. Tension in the vertical posts of trusses with inclined chords is treated fully.

The author's statement that in deck trusses the saving in metal effected by giving the lower chord in end panels an upward inclination towards the ends is usually more than neutralized by the cost of the additional masonry required to carry the bridge seats to higher level may be questioned for the case of abutments, in which the masonry has to be carried to the top in any case and backwalls have to be of the necessary thickness for retaining walls, above the bridge seats. There is also some gain in lateral stability in reducing the depth at ends.

The historical sketch on the development of truss construction necessarily covers the usual ground, but there are some additions to the usual text-book information on this subject and the arrangement is especially good. Under the head-

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ing "Modern Truss Bridges," a classification of truss bridges is undertaken, according to materials, and of steel bridges according to joint connections. The combination riveted and pin-connected truss is not recognized. This type is used in modern first-class railroad bridge design for the larger and heavier trusses in preference to bridges with all joints pin-connected; the members which undergo no reversal of stress are given pin joints and those in which the stresses are reversed, riveted joints, the latter being the middle web members. This type is generally used for trusses with stiff or counterbraced web members, and with eye-bars for bottom chords and non-reversing diagonals.

The author states the advantages of pin-connections but omits those of riveted connections. It seems time to recognize that other elements than span length fix the choice of pin or riveted connections. Magnitude of section of tension members is quite as important an element as span length. When the sections of riveted tension members get to a certain size it becomes, within the usual limitation of lateral dimensions, difficult to splice these members with rivets. Eye-bars are then resorted to. Pin-connections are usually chosen merely as an accompaniment of eye-bars, the eye-bar being the determining feature and instead of the pin-connected classification, that of "eye-bar bridges" might well be chosen. As an example, the heavier sections required for a four-rail truss would cause eye-bars (and hence pin-connections for the same) to be chosen for a very much shorter span than for a one-rail truss. The growing tendency to use stiff web members for reversing stresses, calling for riveted connections for these members, while the eye-bar members in the same trusses are pin-connected, would again argue for dropping the term "pin-connected" in favor of "eye-bar" as representing a type.

The treatment of skew bridges is the most complete the writer has seen. The statement that the use of skew bridges should be avoided unless local conditions admit of no better alternative and that compared with square bridges they are more expensive admits of some qualification, as for certain conditions in which the direction of the stream or way crossed is skewed to that of the bridge and where square abutments, spaced to give the same clear opening at right angles to the line of stream or way could be used, skewed abutments and superstructure will be found the cheaper, especially for plate girders and pony spans in which the cost of portals does not enter, height of masonry being a governing factor. The author's definition of angle of skew is not in accord with the usual conception; he defines it as the angle between the center line of the bridge and that of the crossing. The reviewer believes that it is generally considered, and logically so, that the angle of skew is that between the normal to the center line of bridge and the line joining the centers of truss or girder bearings at a given end of the span. The ends may have different skews and need not be parallel to the line of the crossing. The mention of squaring the ends of the stringers in skewed bridges is commendable and might well be made more prominent.

The introduction of an article on the determination of lateral clearance in railroad through bridges on curves, which is thought to be unique in this book, is to be commended. The governing considerations are shown by diagrams and a general formula for the distance between trusses is given. There is unfortunately an error made in introducing the center of gravity of the load into the consideration and confusing the vertical through this point with the center line of track and the center line between trusses. The distance e_c in diagrams and formulas should represent the eccentricity of center line of track with respect to the center line of bridge instead of the eccentricity of the center of gravity with respect to the same. The treatment of centrifugal force is excellent and the use, in the examples, of variable speed for increasing curvature is in keeping with the best practice.

Under "Live Loading for Bridges," Cooper's loading system is particularly explained. Articulated locomotives are introduced and a wheel diagram of the heaviest of these to date is given. The interesting statement is made that "there appears to be good ground for the belief held by many engineers that Cooper's E-60 loading is not likely to be greatly exceeded for many years." The articulated engine in question will really give static bending moments reaching the equivalent of Cooper's E-67 for spans of 80 to 100 ft., but with moderate speed of this type, high impact effects should not obtain on spans of such length.

The conventional equivalent load systems are described, also equivalent uniform loads for wheel loads. A point that does not seem to be brought out is that the equivalent uniform load system is not applicable to the web members of multiple intersection trusses and that the "excess plus uniform" load systems are the proper ones for such trusses, the explanation of course being that the forward panel reaction of wheels in advance of the critical panel point passes into other systems of multiple intersection trusses and does not reduce the stress in the member under consideration, whereas in single intersection trusses it must return through the member and reduce the stress therein.

The live loading of Cooper's Specifications for Highway and Electric Street Railway Bridges is exclusively quoted for this class. In view of the fact that Cooper's specifications do not call for the most common governing highway-bridge load, namely, the road roller, and that this load is very commonly specified, it would seem that a description of such loads should be included. Some data on the growing weight of motor trucks, especially for hauling coal, might well be introduced. The reviewer believes that the statement that "for the main truss members the condition of concurrent maximum loading on the tracks, roadway and sidewalks is disregarded by reason of the extreme improbability that such loading will ever occur over any considerable length of the bridge," is erroneous as applying generally to highway bridges of ordinary span lengths.

The author gives the weight of the heaviest electric motor cars, when loaded, as about 100,000 lbs. This is probably a little low.

A comprehensive statement of the object of bracing is given, which may be considered profitably by designers. Wind pressure on bridges is dismissed with very brief discussion. The requirements of the American Railway Engineering Association and Cooper's specifications for lateral forces are quoted. These specifications are of the class which does not call for wind pressure per unit of exposed area. It would seem that some criticism should apply to the omission of moré specific reference to the very common use of specifications which do call for such wind pressure. The treatment of portals is most complete, and excellent in clearness of analysis. The cases of free, fixed and partly-fixed end conditions at bottom of posts are all considered. All the usual forms of portals, including a skewed portal, are analyzed.

The treatment and analysis in the chapter on "Stresses in Viaduct Towers" is exceptionally complete. The improbability of the attainment of the usual amount of tractive force specified (20% of the live load) is well noted. There is an error in the notation of stresses in the longitudinal diagonals due to tractive forces (p. 480). The stresses in diagonals AD and EH should be Ti/l and Ti_1/l instead of Ti/h' and Ti_1/h_1', respectively. The complicated combination of stresses from dead load, vertical live load, wind, traction and centrifugal forces is carefully treated, especially following the American Railway Engineering Association and Cooper's specifications, and a convenient table of combination for the A. R. E. specifications is given. As this table applies correctly only to the A. R. E. specifications and others having the same requirements, it should be so stated. In Combination III., for tension in columns, it would seem that the live load should be taken with or without addition for impact according to the effect of centrifugal force. Unique features are the analyses of unsymmetrical bents and of double-track viaducts. It would seem that this chapter might advantageously take in the analysis of elevated railroad structures, but there is no mention of such structures in the book.

The statement that aside from considerations of appearance, camber is provided to bring the abutting ends of compression chord members to square bearing under full load is hardly admissible under modern methods of construction. In the days of unrestrained butt joints, as when the compression members were simply butted against cast-iron joint blocks and held in place by their stresses and by two or more bolts through angle lugs, this was certainly a main reason for camber, but such construction is not used to-day and the heavy splices used must practically hold the ends of the members just as they are when the splices are riveted, which would be when the truss is fully cambered or swinging under dead load only. Unless the chords are riveted when straight and sprung as whole to the camber required for connection of the webs, camber in modern construction must be regarded as a detriment rather than an aid to eliminating bending stresses and eccentric stresses in chords.

The Design and Lubrication of Bearings.

Reviewed by JOHN J. FLATHER,* M. Am. Soc. M. E.

BEARINGS AND THEIR LUBRICATION.—By L. P. Alford, M. E., Editor, "American Machinist," M. Am. Soc. M. E.; M. Am. Soc. for Testing Materials, New York, London and Berlin: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 235; 131 text illustrations; 47 tables. $2.50, net.

The aim of this book is two-fold: to present the underlying principles involved in the design of all classes of machinery bearings, and to show modern practice in the construction and application of important commercial types.

The author has had exceptional opportunities for acquiring information and valuable data relating to the design and lubrication of all kinds of bearings, and the material presented is especially rich in illustrations of type and form of high-speed bearings and friction-reducing methods employed, both in this country and abroad. The work is not essentially a compilation, as many of the data have never before been published in any form, and many of the experiments and researches quoted are from European sources not generally available to American readers.

Not since the presentation of Dr. Thurston's pioneer treatise on "Friction and Lost Work in Machinery" (John Wiley & Sons, 1903) has anything of such value appeared on this important subject; and the author has done a service which will be appreciated by all who have to do with the design or operation of machinery. To the student of engineering the value of the book has been greatly increased by the liberal quotations from the various recognized authorities on this subject and by the very complete references in each case, thus enabling the reader to investigate the original sources of information if a more detailed study of any particular phase be desired.

The work is separated into two natural divisions: Part I treats of bearings with sliding contact; and Part II discusses bearings with rolling contact.

In the first part the modern accepted theories of friction are presented, for it is recognized that a knowledge of the laws of friction is absolutely essential to the design of successful bearings. The laws of Morin and the more recent laws formulated by John Goodman are discussed and their limitations pointed out; in this connection the tables of coefficients of friction determined by various experimenters are of particular interest. From a careful study of all the material on this subject the author presents a series of five laws of friction for well-lubricated surfaces, but he adds that it is uncertain just how far these apply. The proposed laws are:

(1) The coefficient of friction for well-lubricated surfaces is practically independent of the materials composing the bearings and journals, but is dependent upon the nature of the lubricant.
(2) The coefficient of friction for well-lubri-

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cated surfaces is from 1/6 to 1/10 that for unlubricated or scantily lubricated surfaces.

(3) The coefficient of friction for moderate pressures and speeds varies approximately inversely as the normal pressure; that is, the frictional resistance per unit of area is a constant assuming the speed constant. The total frictional resistance varies directly as the area,

$$\text{Or, } \frac{f_1}{f_2} = \frac{p_2}{p_1} \text{ and } f_1 p_1 = f_2 p_2$$

(4) The coefficient of friction for well-lubricated surfaces for a given pressure is very high for low-rubbing velocities, though decreasing rapidly as the velocity increases. For velocities from 100 to 500 ft. per minute it decreases, varying approximately as the square roots of the velocities; for velocities from 500 to 1,600 ft. per minute it decreases at a lower rate, varying approximately as the fifth roots of the velocities; for velocities about 1,600 ft. per minute, it is practically independent of the velocity.

Or, for velocities from 100 to 500 ft. per minute

$$\frac{f_1}{f_2} = \sqrt{\frac{v_1}{v_2}}$$

Or, for velocities from 500 to 1,600 ft. per minute

$$\frac{f_1}{f_2} = \sqrt[4]{\frac{v_1}{v_2}}$$

Or, for velocities over 1,600 ft. per minute

$$f_1 = f_2$$

(5) The coefficient of friction varies approximately inversely as the temperature up to a point just before abrasion takes place.

The statement of the third law is lacking somewhat in clearness. It would have been better to have expanded and modified this, and also, even at the expense of repetition, to have inserted the words "for well-lubricated surfaces," so as to emphasize the fact that this law does not apply to cases of ordinary lubrication. For ordinary lubrication the coefficient of friction is more nearly constant under varying loads, in which case the frictional resistance per square inch varies directly with the pressure per square inch.

The friction of journal, collar, step and guide bearings is quite fully discussed in what follows, and here again the results of numerous tests are presented in convenient form for comparison and deduction.

Materials for bearings of various kinds and use are given considerable attention, and much testimony of a practical nature is presented, from manufacturers and others, regarding the behavior of certain materials under varying conditions, which should be of particular value to machine designers. In discussing the physical characteristics of materials and their effect, it would seem that some brief statement might have been given of the Brinnel hardness scale, and possibly a description of the use of the apparatus, since an increasing amount of attention is being given to this method of determining the hardness of materials for bearings.

The allowable bearing pressures, speeds and temperatures are discussed in another chapter, in which various allowable bearing pressures, in pounds per square inch of projected area, are given in convenient tabular form for practically every class of machinery when operating under the varying conditions of practice. An interesting and valuable curve is noted in this connection which gives the maximum safe bearing pressures for rubbing speeds up to 5,000 ft. per minute and for perfect film lubrication. It shows the practice of the General Electric Co. for the bearings of electrical machinery and is representative of the best American practice.

In regard to the permissible rise in temperature the author points out a truth, which is not always accepted, when he states:

> There is no valid objection to running a bearing hot, provided the temperature reached is not sufficient to do harm and provided there is no progressive increase in heat-indicating trouble. This is opposed to the ideas of some machinery users who look upon any bearing that warms up as improperly designed. There is no reason in expecting or demanding that a machinery bearing should run stone cold.

The design of journal bearings is taken up under separate heads, as follows: (a) Proportions and dimensions of diameter and length; (b) selection of the bearing material; (c) provisions for anchoring the bearing metal if a soft lining, and provisions for adjustment to preserve fit and alinement; (d) clearance between journal and bearing; (e) provisions for lubricating; (f) provisions for radiating and dissipating heat.

Empirical rules established by leading manufacturers and others apply for the most part to this division of the subject. The discussion under provisions for lubricating and for radiating and dissipating heat is particularly worthy of careful consideration, since these features of design, if we except electrical machinery, are so often neglected.

In his presentation of the subject of lubricants the author does not enter upon the chemistry of oils, but limits his discussion to the physical properties of some of the more important kinds of oils and greases, and their applications. Standard specifications of oils are presented for various purposes, as in use by the Pennsylvania Railroad Co. and by the U. S. Government.

The chapter on the design of sliding surfaces and special bearings contains a valuable discussion adapted from Professor Sweet's little book, "Things That Are Usually Wrong." The underlying principle is to make the wearing surfaces of equal length; various examples from practice show the application.

The remaining portion of Part I is devoted to a consideration of typical designs of bearings and suggestions on the care of bearings. This section presents, by line drawings and a few halftone engravings, a number of typical bearing designs, constructions and lubricating systems that appertain to American practice. In the space available, it is obviously impossible to present more than a very few such illustrations, but these have been well chosen and represent a wide range.

The rest of the book, Part II, consisting of about fifty pages, is devoted to a consideration of Rolling Friction. The author states that

> the exact nature of rolling friction is not accurately known, but much splendid experimental work has been done with bearings that involve this principle and we have empirical laws to govern designs. However, there is no theoretical investigation giving results that can be applied to ball and roller bearings in the way that the work of Professor Osborne Reynolds can be applied to journal bearings with sliding contact. * * * A consideration of the properties of ordinary journal bearings—bearings with sliding contacts—and ball-and-roller bearings presents a series of contrasts. At the outset, we have sliding contact contrasted with rolling contact. In the journal bearing the friction is governed by the quality of the lubrication. The better the lubrication the less the friction. In ball and roller bearings the reverse is true. It has been demonstrated by experiment that a well-designed ball or roller bearing may give a lower coefficient of friction when running clean and dry than when lubricated with even a thin oil. This must not be taken to mean that such bearings should be run without oil or grease, for the reverse is necessary. In perfectly lubricated journal bearings there is no metallic contact between the surfaces. In ball and roller bearings there is always metallic contact.
>
> The coefficient of friction for sliding contact is much higher than for rolling contact. The coefficient of rest and slow motions for sliding contact is very much greater than for motions at ordinary speeds. The coefficient of friction for the beginning of motion with rolling contact is not much, if any, greater than for motion at ordinary speeds. For this reason ball and roller bearings are peculiarly adapted for machinery having a high-starting torque. In journal bearings running at a high-rubbing speed the dissipation of heat becomes an important problem. With properly designed and operated ball and roller bearings the amount of energy liberated in heat is so slight that it is a negligible factor in design. Cooling devices are not used. With journal bearings practice indicates that a limiting speed is soon reached.

The design of roller journal bearings and radial ball bearings follow, based largely upon the work of Professor Stribeck. Examples of the construction of ball bearings of various types and for various purposes are presented and a large number of illustrations show typical designs and mountings for ball bearings drawn from American and European practice, which apply to a wide range of machinery.

The question of lubrication of ball bearings is discussed at length. It is shown that ball bearings must have a certain amount of lubrication; although the principle of action of ball bearings involves a purely rolling motion, there is in the most perfectly designed bearing a sliding action which, however slight, must yet be provided for. The author says:

> If balls and raceways were absolutely incompressible there would in practice be solely point contact and, therefore, a pure rolling action, but as far as present-day mechanical processes go, even the most perfect of materials are somewhat elastic and there is an actual area of deformation between the ball and the faceway under load. At the extremities of this area, whose diameter is, of course, very small, sliding must exist, but the presence of a lubricant at this point renders what small amount of friction there is almost negligible.

Applications of roller bearings of various kinds are given and formulas for their use are presented. The Hyatt flexible roller bearing, many forms of solid roller bearings, conical journal bearings and thrust bearings of various types, are shown and proportions given for their use.

The numerous line drawings which accompany the text, many of them dimensional, add greatly to the value of the book as a work of reference, which must be accepted as a distinct and valuable contribution to the literature of machine design. It is to be regretted that in a book of this character the index is so meager; certainly its value would have been increased if more attention had been given to this very important part of a book of reference.

Technical Writing.

Reviewed by H. P. BREITENBACH, Ph.D.

THE THEORY AND PRACTICE OF TECHNICAL WRITING.—By Samuel Chandler Earle, Professor of English in the Engineering School, Tufts College. New York: The Macmillan Co. Cloth; 5 × 7½ ins.; pp. 301; many text illustrations. $1.25, net.

English courses in engineering schools are of two kinds, conforming to two general tendencies, sometimes mutually antagonistic, in present-day engineering education. The typical course of the first kind is usually distinguished as general or cultural in its nature. Its underlying theory is that the engineering student needs to have his powers of expression and of literary appreciation developed, for the same reason and in much the same way as does any other college student. Indeed, originally engineering students in universities received such instruction in the same classes with literary students. In some universities this procedure still holds. Most of them, however, have found it advisable to teach engineering students in separate English classes; and in these there has gradually been evolved a system of instruction better adapted to such students. The purpose of these courses, however, remains, and no doubt wisely remains, that of developing the mind of the engineering student by arousing and guiding his latent powers of expression and of literary appreciation.

Out of the closer adaptation of the work to the needs of the student has arisen a course of a different sort. It is based upon the idea, now fast gaining ground, that the higher command of English is necessary to the engineer, not alone as a college graduate, but as an engineer pure and simple. In other words, according to this view, a typical engineering operation can no more be conducted without the use of "higher English" than it can dispense with higher mathematics. As to whether courses in technical English should, accordingly, be introduced into the curriculum, there is still diversity of opinion among the engineering schools; but in the larger institutions the last half-dozen years show a marked tendency in that direction. A glance at the catalogs of a few representative schools shows courses in general technical writing, in writing specifications and contracts, in business-letter writing, and in technical journalism.

In short, whereas the English course of the first kind corresponds to the tendency in engineering education to lay a broad foundation of general principles upon which the graduate may rear his edifice of practice according to circumstances, the typical course in technical English accords with the other tendency, sometimes opposed to the first, to train the student narrowly for his place in the profession. Both movements are directed toward the correction in students' education of certain inadequacies which the careers of graduates are supposed to have brought to light.

In recognizing their shortcomings in the use of English, engineers themselves, as the present

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reviewer noted in this Supplement for Jan. 19, 1911, p. 6, have been among the first. As an outcome of the frequent discussion of the subject, occasionally a book has appeared from the pen of an engineer wherein he has endeavored to assist students of engineering and his fellow engineers in the use of language. But inevitably most of these efforts, well-meaning as they have been, have seriously failed in their aim. For the writers, while perhaps themselves skilled by long practice in the art of expression, had never made a thorough study of the science of rhetoric; and in most cases, too, being without pedagogical training or experience, they had not understood the needs of students and other novices in expression.

In the book-review referred to above, it was noted that books promising to be free from these defects would soon issue from the press. One such has recently appeared, "The Theory and Practice of Technical Writing," by Samuel Chandler Earle, Professor of English in the Engineering School of Tufts College. It is based upon the theory that the form of expression of which the engineer makes use is special and characteristic. Consequently, while maintaining a sound basis in the general principles of rhetoric, it yet particularly addresses itself to the peculiar problems of expression which confront the engineer as such.

In so doing, however, Professor Earle has not hesitated to reinterpret the conventional rhetorical principles in terms better adapted to the realistic purpose which determines the engineer's use of language. The general principles he recognizes are those of accuracy, completeness, logicalness and economy. That these are natural and useful ideals to maintain in teaching technical composition, the present reviewer can bear personal testimony, since for several years past he has made use of the identical principles in teaching a course in the writing of specifications and contracts.

While the other principles are not neglected, the main emphasis of the book lies heavily upon the element of logical structure. Some persons may think it an over-emphasis; but, from the pedagogical standpoint, provided only that the student's spontaneity and power of initiative receive thereby no undue repression, the element of logical structure can scarcely be over-emphasized. The great bane of English teaching is the over-insistence on matters of minor importance both actually and educationally. Even in the numerous illuminating discussions of the teaching of English at meetings of the Society for the Promotion of Engineering Education, all too frequently the emphasis has been laid upon spelling and other minor matters which are no more the significant elements of the subject than is freehand lettering of mechanical drawing. For it cannot be too often insisted (truism though it may be) that the primary function of language is to communicate *thought*. This fundamental principle Professor Earle has kept in mind throughout his work. Consequently he has devoted his attention first and primarily to the problem of the proper development of thought in its larger phases, and only later and secondarily to the details of expression.

Logical structure Professor Earle developes through the "synopsis," as he calls it, or as it is more often called, the "outline." This form, the nature of which scarcely needs explanation, by means of a system of indentation aided by one of lettering and numbering, presents the substance of a piece of writing, actual or projected, in such a way as to exhibit its logical interrelations. With its aid a composition may more readily be criticized from the viewpoint of any one of the principles, but especially from that of logicalness. Still further to aid the process of criticism, Professor Earle re-states the general principles in the form of a number of definite, practical rules; these may be used to test an outline and thus to criticize a piece of writing, whether already written or only contemplated. By such means the element of structure is emphasized throughout the book.

As the title of the book indicates, the subject of technical writing is presented with reference to both theory and practice. In the theoretical half of the book, the nature and the use of the synopsis are developed, first, by analyzing a piece of technical exposition, and then by building up in this form logical structures such as might be used for purposes of composition. In successive chapters are then worked out the essentials of logical structure in the various cases of "descriptive exposition," "narrative exposition," "directions," and combinations of these. In the second half of the book the author explains the practical application of the principles. In these five chapters he discusses the problem of addressing general readers, and that of addressing specialists; reviews the standard rhetorical principles in their reference to the form of the final writing; and, lastly, gives some good suggestions on general methods of composition, with hints on the preparation of MSS. for the printer. An appendix contains more than fifty pages of examples of technical writing, to serve as illustrative material.

In planning the book in this form, Professor Earle aimed to make it serviceable both for engineering student and for practicing engineer. For undergraduates it may be used, the author suggests, either as part of a more general course, or as a separate advanced subject in the junior or senior year. To render it the more serviceable to engineers, he has made Part II. practically complete in itself, while giving in connection with it frequent references to sections of the preliminary study in theory.

That the book will prove successful in both its aims, appears altogether likely. It is marred by some defects, but by few that need materially affect its usefulness. Most authorities would probably not, as does Professor Earle, include in exposition (to which field the author specifically limits himself) composition whose purpose it is to convince. On the other hand, most authorities would not feel satisfied to analyze exposition, as does Professor Earle, into descriptive exposition, narrative exposition and "directions." Moreover, and perhaps we have here the clue to both the other errors as well, the author confines exposition too closely to what he calls "facts," whereas certainly the primary business of exposition is with ideas, to which facts, properly so-called, are only subsidiary. It may be that this is mere quibbling about a matter of nomenclature; and yet, even were it so, it would seem inadvisable to confuse in any way the useful distinction between the concrete and the abstract. It should be added that certain of Professor Earle's definitions are not clear cut; sometimes, also, needed definitions, as in the case of "facts" just referred to, are altogether lacking.

The most important point for criticism, however, hinges on the fundamental nature of the kind of "drill" on synopsis that is indicated by the book. The amount of this work suggested has already received commendation; the question now raised is as to its nature. For the model outlines are presented in a way that would seem to encourage in the student a mechanical attitude toward English, causing him to lose, or at least to fail to be imbued with, the sense of the vital, organic character of composition. If it did so, his own writing would soon become stiff, wooden, stilted, without freshness or life. This is, of course, a serious danger. Fortunately, it appears to be somewhat minimized in the present case by the nature of the book itself.

For Professor Earle's own style in this book is fresh, easy and unaffected, not at all stiff or lacking in life. Moreover, these commendable qualities appear to have been attained by him without deviating from the principles he enunciates. Accuracy, completeness, logicalness, economy,—in general, they are beautifully exemplified in this book. The very defects in the style of the work seem to prove the rule by reason of their exceptional nature; they have arisen from not following the principles, rather than from observing them too sedulously. Indeed, the author has, on the whole, most commendably practiced what he preaches; and thus he appears to have vindicated his principles and the nature of his method. But the important thing is that he has done something more and beyond: he has not, it is true, transgressed his principles, but he has transcended them. In short, he has vitalized the book with his own spirit. The danger is, then, that this point may escape the student. Perhaps misled by the emphasis on the mechanical element in style, he may fail to learn, or to be taught, that the primary essential to effective composition is a vital idea, the force of which must imbue with its life and hence organize both the general structure and the uttermost detail of style.

As already noted, where the book shows defects in style, it is because Professor Earle has failed to observe the principles he enunciates. So, for example, he discusses very ably the rules for sentence structure and punctuation; but the two sentences quoted below have evidently escaped the application of these principles:

> Even if care is exercised, in presenting a long series of coordinate ideas, to connect each member with the preceding and with the following, after six or seven have been given, the reader who is getting first knowledge will find the earlier members of the series slipping from his mind. (p. 47).
>
> When division into paragraphs is enough and how—if it is not—other means of marking divisions may be used along with paragraphs, we shall consider later. (p. 185).

Further similar matter for criticism might be quoted, but where so much deserves commendation, the task were an ungrateful one. For, minor defects aside, by his accurate, careful, orderly treatment of his topic, Professor Earle has placed both teacher and student as well as practicing engineer largely in his debt. Subject only to the possible qualification already discussed, the book should fulfill admirably the aims of its author.

For the undergraduate, the work, either as part of a general course or preferably as the basis of a separate advanced course, should prove a serviceable introduction to technical writing. The recent graduate, who, because of the educational situation explained at the outset, probably has had only a general course in composition, will likewise find the book useful in supplementing his education. The engineer of an older growth may very likely have learned by more or less costly experience much of the detailed matter which the book contains; he, too, however, will be glad of the opportunity to have his knowledge coordinated and, at points where it needs it, reinforced. To the last two classes, especially, the system of cross-indexing already mentioned and a serviceable index will commend themselves as affording convenient access to a very valuable contribution to the literature of technical writing.

ELECTRICITY IN LOCOMOTION.—An Account of Its Mechanism, Its Achievements, and Its Prospects. By Adam Gowans Whyte, B. Sc., Editor of "Electrical Industries and Electrics." Cambridge, England: University Press. New York: G. P. Putnam's Sons. Cloth; 4¾ × 6¾ ins.; pp. 143; 18 text figures. 1s., net; American price, 40 cts., net.

The author notes that he has attempted "to give a clear picture of the part which electricity has taken and will continue to take in the development of locomotion," meaning thereby to illuminate the laiety on the engineering and economic aspects of electric traction. The book deals exclusively with electric "tramroads" and "railways" in England and is interesting to the engineer because it says very little about electric-railway engineering and considerable about historical and political events involved. The legislative handicaps under which tramways have labored are very evident from the author's discussion. He does not show, however, a master hand in popularly describing technical works and explaining engineering principles to those who know nothing of them to start with.

The first three chapters are historical and the fourth discusses how electric traction is cheaper and more advantageous than animal. With the fifth chapter the author begins his very abbreviated descriptions of various technical features—overhead, conduit and surface-contact systems, the "trackless trolley," storage-battery cars and automobiles, the electrification of steam roads, etc., etc. These sections are interspersed with discourses on financial burdens, lack of development, etc., peculiar to England.

Analytical Mechanics and Structural Engineering.

Reviewed by ROBERT FLETCHER,* M. Am. Soc. C. E.

ANALYTICAL MECHANICS.—Comprising the Kinetics and Statics of Solids and Fluids. By Edwin H. Barton, D. Sc. (Lond.), F. R. S. E., A. M. I. E. E., F. Ph. S. L.; Professor of Experimental Physics, University College, Nottingham. London, New York, Bombay and Calcutta: Longmans, Green & Co. Cloth; 5½ x 9 ins.; pp. 535; 241 text illustrations. $3, net.

STRUCTURAL ENGINEERING.—By Joseph Husband, Associate Member and Watt Medallist of the Institution of Civil Engineers; Associate and Medallist of the Royal College of Science for Ireland; Member of the French Society of Civil Engineers; Head of the Civil Engineering Department of the University of Sheffield; and William Harby, sometime Assistant in the Civil Engineering Department of the University of Sheffield. London, New York, Bombay and Calcutta: Longmans, Green & Co. Cloth; 5⅛ x 9 ins.; pp. 396; 337 text illustrations. $2.60, net.

These are both excellent treatises in their respective fields. They share in common the merits of other English technical books in that they weigh less than two pounds each, a fairly convenient weight for the hand, and have from 550 to 600 words to the page, in plain, readable type, on a good quality of book paper. A well-known American treatise on technical mechanics has 125 less pages and barely 400 words on a page, while it weighs six ounces more and contains, on the basis of word counting, less than 60% as much subject matter. The price of the first is $3 net, of the second $2.60 net, and of the American book $4, retail.

The author of the Analytical Mechanics prefers to develop the subject in the order: Kinematics (167 pp.), Kinetics (122 pp.), Statics (125 pp.), Hydrostatics (21 pp.), Hydrokinetics (20 pp.), and Elasticity (7 pp.). Many American teachers think that the subject is more effectively, even if less logically, unfolded by considering Statics as the first branch or division. The method and scope of the author's treatment are thus stated in the preface:

> This text-book on theoretical mechanics is intended for those possessing, or concurrently acquiring, an elementary knowledge of the calculus. Within these bounds it is fairly complete, dealing with the kinetics and statics of solids and of fluids. Further, in the kinematical portion, mechanisms and strains are included, and the work closes with a short chapter on elasticity. Probably most users of the book will bring to its study some previous knowledge of the subject, the amount and freshness of which differ widely in individual cases.

The opening sentence is too vague: "The theory of mechanics deals with space, time and mass." Wright is more definite and complete in saying: "Mechanics treats of matter, motion and force, and their measurement"; thus including the primary concepts only—since motion involves both space and time—and not omitting the essentially quantitative aspect of the study.

Professor Barton first calls attention to the physical and chemical aspects of mechanics and draws the line of separation from the analytical treatment. In two chapters he gives a brief review of the mathematical formulas needed and a very good exposition of the geometrical basis, including the usual "graphs" of a moving point, for velocity, acceleration, displacement, etc. Kinematics is treated in eight chapters, including rectilinear, plane and plane rotational motions, "solid" motions of a point and "solid" rotational motions, mechanisms and strains. (When will writers drop this atrocious use of the term "solid"? *General motion* or "motion in space" are correctly expressive; but solidity concerns only the body acted upon, while the space in which its path is described cannot be imagined as solid in any respect.)

The treatment of orbits is a little more complete than usual, including—besides an alternative proof that the natural orbit is a conic—the hyperbolic orbit and its hodograph, and discussions of the relations of the variables of an elliptic orbit. Besides the discussion of motion in a vertical cycloid and the cycloidal pendulum the problem of the brachistocrone or curve of swiftest descent is discussed on three pages. In the treatment of motion in three directions it is a little confusing to American students to symbolize the three directional cosines by l, m and r instead of by the usual trigonometrical forms. Cylindrical, conical and spherical motions (spherical pendulum) are treated under this head, and the general equations for motion on any curve. Rotational motions are presented by deducing Euler's theorem, Rodrigue's coordinates and theorem, discussion of precessional motion and general precessional rotation, and the most general motion of a rigid body with one point fixed, etc. The 24 pages devoted to mechanisms includes discussion of partially deformable figures, especially the usual linkages with rigid links. The 32 pages on strains discuss pure strains and shear, homogeneous strains, the strain ellipsoid, shear ellipsoid and restricted strains.

Concerning Chapter XI. (pp. 19), which is a marked feature of the book, the author says in the preface:

> In the transition from kinematics to kinetics, Newton's principles and the views subsequently held respecting them are passed in review. This critical treatment culminates in a set of proposed enunciations. To minds thus prepared these enunciations, though brief enough to be easily remembered, may serve to recall a sort of central position of modern thought on dynamical axioms. But no finality has yet been reached on these philosophical topics. Their discussion is accordingly confined to a single chapter. This leaves the formal mathematical developments equally readable to those holding the most diverse views as to the foundations underlying this superstructure.

This chapter includes a short bibliography naming Newton's Principia (1686) and nine recent works by: H. Hertz (Leipzig); H. Poincaré, "Science and Hypothesis," London, 1905; E. Mach's "Relation of Mechanics to Physics," in "Science," Jan. 12, 1906; and English works by Lodge, Love, Pearson, Russell and Herbert Spencer.

The following "examples" close the chapter:—"Do you consider the mechanical creed as enunciated by Newton needs revision? If so, state in your own words by what you would replace it. If not, defend Newton from his various critics." No. 6 calls for a translation of four paragraphs from a French author and criticism of the statements and queries quoted—including definitions of *mass* given by Newton, Thomson and Tait, Lagrange and Kirchoff. Certainly one qualified to give clear and succinct answers to these must have more than a novice's grasp of the subject.

Lack of space forbids equally extended review of kinetics and other divisions, but we may notice interesting discussions of the Atwood machine with friction and inertia of the pulley, the pendulum in accelerated chamber, motion of three connected masses, chain falling on a table, chain uncoiling from a table, fall of growing raindrop, and slip of snow on a slope; also the fall of a trap door from a vertical and from a horizontal position; sphere and cylinder with initial rotation on a rough level plane and on inclines; precession of the top and other phases of gyroscopic motion, and motions of a quoit. Moment of inertia is treated on 18 pages with more generality but not so completely as by Maurer in "Technical Mechanics" or by Hancock in "Mechanics for Engineers." *Attraction and potential* have a little fuller treatment than by Maurer, by inclusion of graphical representation of fields, field in eccentric spherical cavity, a page on the Newtonian constant of gravitation, lines and tubes or cones of force and Gauss', Laplace's and Poisson's theorems. The two chapters on statics of rigid bodies have a rather meager treatment of center of gravity and equilibrium; but a very good presentation of the leading principles of graphical statics in 24 pages.

The chapter on hydrostatics is quite brief from the standpoint of an engineer, and yet discusses pressure on a curved membrane of uniform tension, soap bubbles and films, capillary ascent and equilibrium form of a large drop. Paradoxically, brevity of the latter chapters may not be considered a shortcoming, for the author evidently intended to draw the line sharply between rational and applied mechanics. In the short chapter on hydrokinetics he treats the subject quite theoretically by developing fundamental equations of great generality, including angular acceleration of the elements of a liquid, and water waves.

Scattered throughout the book at intervals of four to six pages are groups of examples from two or three up to ten or twelve. These are largely drawn from "London, B. Sc., Pass, Applied Math." examination papers. There are above 800 of these, which occupy space of about 80 pages, of which 286 are in special classified lists covering wholly the last 36 pages. A few quoted from German and French authors must exercise the student in translation. Many of these are merely mathematical stunts; some need more explanation and illustrations, and others probably could not be solved off-hand by one who had not recently followed closely the methods and formulas as developed by the author. About one-third of the more practical and practicable of the examples would be sufficient. Then if the 40 or 50 pages thus released were devoted to a concluding section *exemplifying* the leading principles, the interest of the student and effectiveness of the course would be increased. For example: published diagrams or graphs of acceleration, and speed tests of electric and steam locomotives, same of the behavior of some noted ships in the launching, Westinghouse's use of a principle of friction in his collision buffer, the accelerometer in starting and stopping of cars*, observed results of impact of projectiles†, etc. An instructor who maintains a lively interest in the subject among his students must have a large stock of such references, on which he may require reports, or make his own presentation for elucidation of the text.

No adverse criticism is intended in these comments. Opened at random, the book is interesting and instructive at almost any point. The American book most resembling it is Maurer's; but the American author has adapted his book better to the needs of engineering students. Hancock, whose work has been cited, amplifies on topics of chief practical importance, and supplies many examples of practical value, although his work lacks logical arrangement and completeness. Barton's work cannot fail to be useful to teachers and acceptable to students who have passed beyond the mere elements, and who can apply the simpler principles of the calculus in analysis.

Husband and Harby's work on structural engineering is an excellent compendium, covering the subjects which are more fully treated in several American text-books on graphical statics and analysis of framed structures, with a chapter of 72 pages on masonry and masonry structures, including arches and a brief section on chimneys, not omitting steel columns and column foundations. The theory of retaining walls is well and tersely presented. Rankine's theory and formula are stated in a paragraph, with the remark that it gives pressure 25 to 30% greater than the actual in most cases. Rebhan's graphical method is developed at length and applied to examples. The usual English patterns of curved walls and counterforts and retaining arches are described.

In the discussion of theory of beams and trusses the applications of the usual moment and shear diagrams are well demonstrated, but the methods by influence lines are not introduced. In the chapter on "lattice girders" the authors group under this head about every form of truss in use—even bowstring and lenticular girders, the triangular truss and quadrangular trusses of the Howe and Pratt types, and draw-spans. This, of course, does not accord with the classification of American engineers. The design of plate girders and rivetted trusses is as complete as the scope of the book will allow. Pin-joints have little or no consideration. The chapter on deflections has less than eight pages. From the standpoint of the reviewer it would not be suitable for classwork, because it does not

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*See, in order, Engineering News, Vol. 38, p. 249. Vol. 52, p. 563. Vol. 23, p. 207. Vol. 46, p. 467.

†Impact of Projectiles and Resistance of Armor Plate, with Stress Diagrams, London "Engineering," Apr. 10, 1903, p. 484.

show some phases of more advanced practice in design and construction, and attempts to include too much between two covers. American engineering students would have at least three books to cover the same subjects; but for an abbreviated course it would serve well; as it presents the essentials clearly, tersely, and along the lines of sound theory and practice.

In both books the illustrations are all in the text, a few nearly full page, and all well drawn. Neither is open to the charge of diffuseness of style; and the favorable impression which they make at first glance is fully confirmed by extended persual. The expressed intentions of the authors have been well fulfilled.

Another Book on Electrical Transmission.

Reviewed by HENRY H. NORRIS.*

THE ELEMENTS OF ELECTRICAL TRANSMISSION.—A Text-Book for Colleges and Technical Schools. By Olin Jerome Ferguson, Associate Professor of Electrical Engineering in Union College, M. A. I. E. E.; M. N. E. L. A.; M. Soc. Prom. Eng. Ed. New York: The Macmillan Co. Cloth; 5½ × 8½ ins; pp. 457; 273 text illustrations. $3.50, net.

There are so many books on electric power transmission that one wonders why another should be published. A new book in this line is viewed rather critically. It is true, however, that most of the existing books treat of special lines of work in which the authors are authorities and there is probably none that contains as much of recent practice in all parts of the subject as does this one by Professor Ferguson. He has taken up not only the practical features but has gone into the theory quite deeply at several points. Professor Ferguson has interpreted the elements of power transmission to include the power-house and the prime movers, generators and switchboards which it contains; overhead and underground transmission and distribution circuits, transformers, and motors. These headings cover almost all of the equipment used in electrical installations of all kinds, so that a glance through the index gives the impression that the book aims to cover all existing electrical knowledge. This impression is not correct, however, because the transmission line is given first and most careful attention and allied matters are treated superficially, as is allowable in this case. The author shows such a good grasp of his subject that the reader would have preferred to have him go into yet more detail in regard to the transmission line itself, even if it had been necessary to overlook water wheels, gas engines, etc. The author states in the preface that he has aimed to produce an elementary text-book and that it will probably stand or fall as such.

Passing over the first chapter, on conductors and insulation, which contains chiefly information found in hand-books, we come to two interesting chapters on aerial line construction. The various types of insulators are described and illustrated and the merits and demerits of each are discussed. As the increase in commercial line voltage has been very rapid during the past few years the evolution of the insulator has been correspondingly rapid. A period of slightly more than twenty years has elapsed since the first alternating-current power transmission was installed in this country with a line of voltage of 3,000. Now 100,000-volt transmission is not unusual and the limit is still far away. The insulators shown in the book indicate the steps in transmission line progress from the time when the glass telegraph line insulator was entirely satisfactory for power transmission purposes to the present. Small glass insulators mounted on locust pins developed into enormous porcelain insulators, made up of several shells cemented together, the whole mounted on iron pins. These sufficed up to 60,000 volts, but above that pressure were found to be too expensive and too weak mechanically. Now the suspension type is coming into use rapidly. This consists of porcelain sections, flexibly connected by galvanized iron fittings, and assembled in sufficient numbers to give the desired dielectric strength. Closely connected with the development of the insulator has been that of the supporting structure. At first, small untreated wooden poles were found satisfactory. Now the most important lines are mounted on galvanized-steel towers of a modified windmill type. In special cases, reinforced concrete poles have been found economical and where wood is still used there is an increasing tendency to prolong its life by treatment with creosote, carbolineum or zinc chloride. In connection with these matters the author describes methods of line erection and takes up briefly the construction of high-tension outlets for power stations and substations.

The subject of switchboards and protective devices is closely connected with that of the transmission line and is properly taken up next. A few modern switchboards are used as illustrations in pointing out the engineering features of satisfactory practice. The different commercial types of lightning arrester are described with especial reference to the aluminum type which is used in combination with horn-gap and other familiar arresters. The aluminum arester depends for its operation upon the formation of a non-conducting film upon aluminum electrodes, separated by an aluminum salt solution, when current flows between them. This principle is well known through the aluminum rectifier. The insulating film on the electrodes breaks down at a fairly definite voltage, after which the cell is a fairly good conductor. A number of these cells, arranged in series, are connected between the transmission line and the ground and no current flows under normal conditions. A sudden rise in line voltage due to some disturbance, such as lightning, results in the puncture of the films in the aluminum cells and a discharge to the ground occurs. When the voltage falls again the punctures are automatically healed. The invention and rapid commercialization of such novel devices as this indicates the mobility of line-protection engineering.

With the exception of a long chapter on prime movers and generators, which seems rather out of place, the remainder of the book is taken up with theoretical matters. Slightly less than one-half of the 450 pages are thus used. Various kinds of electric circuits are described and interesting diagrams are given to show how the voltage falls off the conductors. The studies of potential gradient (rate of falling of voltage) are particularly good. The calculation of resistance and reactance of circuits is also described and illustrated by the solution of problems. The treatment includes three-phase circuits. Up-to-date methods used in estimating line voltage regulation, etc., are given and applied to assumed conditions. In the algebra of these problems the symbolic notation is used. This is natural, as the author is affiliated with Dr. C. P. Steinmetz, who introduced the system which is now used by practically all writers on alternating-current theory. Under the caption "distribution," various matters connected with the utilization of electric power are taken up. Transformers and transformer connections, various types of motors and their characteristics, commutation and rectification are some of the topics. There are also short chapters on measurements and line phenomena.

If the author had not stated in the preface that this is a text-book the reviewer would not have put it in that class. It seems more like a good reference book. As a text-book it is not uniform, as some parts are elementary and easy to understand while others are of a most advanced character. Some parts contain much practical information that students need not be bothered with while other parts are highly theoretical. Some parts are pure mechanical engineering, while others are severely electrical. As the author implies in the preface, however, the teacher is the most important factor in the teaching process. In the hands of an experienced teacher this book will give excellent results because it is a mine of information. It should not be used as the basis of a course taught by an academic instructor. It should prove useful as a general reference book to all engineers who are not specialists in transmission line engineering.

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A New Edition of Ketchum's Walls, Bins and Grain Elevators.

Reviewed by EDWARD GODFREY,* M. Am. Soc. C. E.

THE DESIGN OF WALLS, BINS AND GRAIN ELEVATORS.—By Milo S. Ketchum, C. E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado; Consulting Engineer; M. Am. Soc. C. E.; M. Am. Soc. T. M.; M. Am. Ry. Eng. Assoc.; M. Soc. Prom. Eng. Ed. Second edition, revised and enlarged. New York: The Engineering News Publishing Co. London: Archibald Constable & Co., Ltd. Cloth; 6 × 9 ins.; 556 pp; 255 text illustrations. $4, net.

When the present writer reviewed this book in 1907 (see this Supplement for July 17, 1907) he pointed out its excellencies in the way of notes on existing plants, their general details and the elements of their cost. Some additions have been made to this portion of the book. Where these additions concern completed plants, they add to the value of the book. Where examples of retaining walls are multiplied, the addition to the value of the book is problematic: of this more will be said later. A designer may work out problems that relate to strength and stability; he cannot so well work out practical problems that concern the arrangement of a plant.

The reviewer also pointed out some objectionable features of the book in the shape of complex and inappropriate treatment. He believes that in this he represents a large class of designers who are pleading for simplicity and directness in theoretical treatment of engineering design. The author's answer to this is the answer of Rehoboam. More theory, more complex theory, is added to the book. The granular mass theory of retaining walls is the most discredited theory that receives any serious notice on the part of writers. In many cases where this theory would show hundreds of tons of force there is absolutely none. This is especially true when the earth is dry; that is, when it most nearly fits the theory. Earth may slide in large wedges when acted upon by rain, or it may exert a very heavy force through the influence of frost. This force may be locally a maximum near the surface. Prof. Ketchum makes no mention of the effect of frost, the real menace to the safety of many retaining walls.

The analytical portions of the added matter are decidedly disappointing. Especially is this true of reinforced-concrete design. In common with most books that treat of reinforced concrete the analysis is of an inferior order, being both incomplete and inconsistent.

On page 516 an alleged analysis of the stress in vertical stirrups is given. The tension, in a diagonal section through the stirrups, which is "not taken by the concrete," is divided into the stirrups cut. The one cut near the bottom would have to take its full stress from the bottom reinforcing rod. This means that that rod must *carry the shear of the beam to the stirrup*; this is wrong. The one cut near the top must be anchored for its full value by a little pinch in the concrete; this is also wrong. The whole analysis is wrong, because the concrete must take the full shear in any vertical section between two stirrups in any event.

On pages 80 and 491 Prof. Ketchum cites the fact that tests show that initial slip is only slightly retarded by a hook, though the ultimate bond is increased 50%, and yet makes uniform use of a hook for the anchorage of rods! The initial slip is the ultimate limit of usefulness, so far as the designer is concerned: of what use is the post mortem strength of any construction?

In his analysis of a T-shaped wall Prof. Ketchum uses fillets to take the end shear of cantilever slabs. Imagine a plate girder whose web is inadequate being reinforced for shear by adding a corner bracket under it! One of these fillets is incidentally reinforced. This fillet and its reinforcement is the salvation of the wall, but not because of the ostensible reason for which it was introduced. Two examples are given on page 105 where the fillets are omitted. Because of this and other defects these walls are absolutely dangerous. Such examples should

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not be cited, unless their essential weaknesses are shown.

Prof. Ketchum's analysis of the counterfort wall is faulty. He reinforces the bottom slab uniformly for its full width, though the bending moment reduces to zero and then becomes negative, as the vertical slab is approached. He hangs this slab on hooks. It is scarcely likely that any engineer in his right mind would hang a heavily loaded slab *in space* on a few hooked rods. The same thing ought to apply in construction under ground.

Lack of space prohibits the reviewer from repeating the criticisms of his first review. They all apply to this edition, for they have been uniformly ignored.

Some Testing Apparatus and Methods.

Reviewed by NICHOLAS S. HILL, JR.*

EXPERIMENTAL ENGINEERING.—By U. T. Holmes, Commander, U. S. Navy. Annapolis, Md.: The United States Naval Institute. Cloth; 6 × 9⅛ ins.; pp. 311; 152 text figures. $2.50, postpaid.

Mr. Holmes' revision of his "Notes on Experimental Engineering" has the great virtue of being concise. In fact, the author has rather erred on the side of brevity, in places. He has relieved his work, however, of the unnecessary duplication of cuts and diagrams, illustrating various types of apparatus, designed to obtain like results. This policy has eliminated apparatus which, in some instances, is considered more accurate than that illustrated, but in general it may be said that the methods and appliances selected for illustration represent good current practice.

The work, as may be inferred from its title, treats of the methods and apparatus employed in testing the materials and machinery used in engineering. The book may be said to be designed primarily for use in steam-power plant engineering, though reference is made to the measurement of the rate of the flow of water, to the measurement of power by means of dynamometers and similar devices and to the testing of materials of construction as well as of lubricants—information which is useful to engineers in other lines than steam engineering. The data relating to testing of materials, however, are confined chiefly to metals and cement and are not broad in scope.

The author opens his work with a chapter on engineering calculations and, while not deprecating the value of accuracy, happily calls attention to the absurd and time-wasting practice of carrying such calculations to the third and fourth decimal place when the limits of accuracy of the apparatus employed, and of the results which may be obtained, preclude such refinements.

Chapters on instruments for computing and recording experimental data follow. The author, in these two chapters, illustrates and describes, rather briefly, the use of the slide rule, planimeters and other calculating devices, as well as apparatus for exact measurement, for recording pressures, measuring temperatures, etc. Then follow chapters on calculating the flow of air and steam, selecting and testing of fuels and flue gas analysis.

The work covers but a limited part of the field of Experimental Engineering, but it is, as a whole, compact. The text is clear and attractive in its style. The form and appearance of the book are good. The author evidently assumes that his readers will be those who have had previous engineering training. The steam engineer will no doubt find the volume useful and suggestive. While it is not as complete as similar works by Carpenter and others it has one quality of value to the busy engineer, namely, its simplicity and the facility with which a particular bit of information may be found.

WOOD-TURNING: WOOD-WORKING MACHINES AND PATTERN MAKING.—A Text for University, College and Technical High School Shops and for Apprenticeship Courses. By George H. Resides, Instructor in Practical Mechanics, Pennsylvania State College, and Hugo Diemer, M. E., Professor of Industrial Engineering, Pennsylvania State College; Consulting Industrial Engineer. New York and London: McGraw-Hill Book Co. Cloth; 10¼ × 8 ins.; pp. 117; 169 text illustrations. $1.50, net.

While not claiming that their book should entirely take the place of personal instruction, the authors have attempted to put into it the instructions that are necessary for the average student upon beginning to use the wood lathe. By giving the tsudents or appretnices the instructions that all will need in book form, the instruction will be left free to correct the special idiosyncracies of the individuals. Instructions as to the proper position of the hands in holding turning tools is given by means of numerous photographs taken at close range, which show only the operative's hands and the work.

The book has three parts on wood turning, the use of woodworking machines and pattern-making, respectively. The part on woodworking machines describes briefly power-driven saws, planers and jointers and special hand tools, such as core-box planes and the trimmer. Parts I. and III. consist largely of working drawings of various exercises, with brief notes and instructions. In Part III., however, the exercises are preceded by some ten pages of general instructions on pattern-making and definitions of pattern-shop terms. Most of the pattern-making exercises involve more or less lathe work.

The selections, both of exercises and of the points on which detailed instruction is given, based, no doubt, on the author's experience with students at Pennsylvania State Colege, appear to be excellent. Thanks especially to an intelligent use of what are termed the "motion-study" photographs, the book is most concise, and it bids fair to exceed the author's claims, and all but takes the place of a personal instructor.

Works on Physics.

PHYSICAL OPTICS.—By Robert W. Wood, L. L. D., Professor of Experimental Physics in the Johns Hopkins University. New and revised edition. New York: The Macmillan Co. Cloth; 5¾ × 9 ins.; pp. 705; two plates and 399 illustrations in text. $5.25, net.

COLLEGE PHYSICS.—By John Oren Reed, Ph. D., Professor of Physics in the University of Michigan and Dean of the Department of Literature, Science and the Arts, and Karl Eugen Guthe, Ph. D., Professor of Physics in the University of Michigan. New York: The Macmillan Co. Cloth; 5½ × 8½ ins.; pp. 622; 328 text figures. $2.75, net.

A TEXT-BOOK OF PHYSICS.—By Louis Bevier Spinney, Professor of Physics and Illuminating Engineering in Iowa State College. New York: The Macmillan Co. Cloth; 5½ × 9 ins.; pp. 605; 384 text illustrations. $2.75, net.

Wood's "Optics" is essentially a record and discussion of the more intricate and recondite optical phenomena, those which interest chiefly the scientific investigator. Lenses are treated very briefly, and lens systems are passed by, so that what the ordinary man regards as the main part of optics is all but left out of the book. On the other hand, there is very full discussion of diffraction, anomalous dispersion, polarization, Zeeman effect, and other phenomena in which the physical investigator is vitally interested. Nevertheless the book is likely to prove very absorbing to the ordinarily intelligent man who preserves a fondness, even though an amateurish one, for the wonders of physical experimentation.

Prof. Wood's rare skill in devising and conducting experiments is duly manifest in the book. His photographs of sound-waves, his reproduction of mirage effects, his "fish-eye" camera views, and many other experiments of equal interest, are recorded, and it is proper to say here that in every case their mention is characterized by great modesty.

Generally speaking, the book forms so animated a review of experimental development of physical facts that the reader is certain to find it highly engaging reading even though the mathematical chapters are above his head.

"College Physics" covers the whole domain of physics in condensed expository form, as suitable for general college courses. It is quite similar to its predecessors in the same field, but is measurably fuller, i. e., more complete, than most other text-books. The authors' style is excellent, clearness and precision being combined effectively.

The general use of such a book as this would be favored by the addition of references. Since it is necessary to confine the text to elementary or at best only sketchy statements, at many points even to less, the reader should be assisted in further study of any point he may wish to examine more thoroughly, by being referred to works where the point in question is detailed. The present work contains practically no such references; in this respect, however, it does not differ much from other college text-books, whether on physics or on any other subjects.

Spinney's "A Text-book of Physics" is distinctly more didactic in its style, and as it also aims to emphasize the practical applications of physical principles its total range is considerably less than that of Reed and Guthe's work. While mathematical symbols are freely employed, analytical work is in general avoided. The book may be regarded as an "easier" course in physics. Its announced purpose, "as a text in courses offered to engineering and technical students," is fairly met.

A new Canadian journal brought out its first issue a few weeks ago: The Railway Journal of Canada, size 9 × 12 ins. The technical contents of a paper can hardly be characterized from an initial issue, but the 32 text pages give evidence of a strong effort to fill the field in serviceable style. Articles on track elevation at Toronto, the cross-tie problem in Canada, and a new roundhouse of the Grand Trunk, occupy the leading position. Nine pages are devoted to electric railway matters. The Commercial Press, Ltd., of Toronto, publishes the new journal. Gordon C. Keith and J. C. Armer are editors.

THE STEAM TURBINE.—The Rede Lecture, 1911. By Sir Charles A. Parsons, K. C. B. Cambridge, England: The University Press. New York: G. P. Putnam's Sons. Cloth; 5 × 7½ ins.; pp. 57; 51 text illustrations. 50 cts., net.

Naturally great interest centers in what an eminent authority, like the author, considers essential points for a single short lecture or a booklet on so great a subject as the steam turbine. There is, perhaps, added interest since the author is one of the few true pioneers in this field and his works have shown their merit without drawing heavily on the efforts of a publicity department.

This lecture seems to show particularly the breadth and scope of the author's activity in perfecting a great variety of apparatus to meet diversified conditions of service, especially in marine service.

The author first describes some of his early work and the gradual evolution of the modern Parsons type. The theory of the action of this type and the other few distinctive designs are briefly stated—together with the advantages each type possesses and under what circumstances one system becomes more advantageous than another. Then the author passes to marine uses and to the demands of the propeller on the turbine designer and vice versa.

The lecture closes with a review of the notable work on board the "Vespasian"—a slow cargo steamer equipped with two Parsons turbines connected to a single propeller shaft through double helical gears in rigid bearings. The field thus so successfully opened up is very conservatively mentioned.

The book will give the expert nothing new about Mr. Parson's machines. But it will give the appreciative mechanical-engineer reader a plain and interesting exposition of a remarkable work and more than that—a pleasant personal talk from a great mechanician.

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Streets in Relation to City Planning.

Reviewed by CHARLES W. LEAVITT, JR.,* M. Am. Soc. C. E.

THE WIDTH AND ARRANGEMENT OF STREETS.—A Study in Town Planning. By Charles Mulford Robinson, Author of "The Improvement of Towns and Cities," "Modern Civic Art" and "The Call of the City." New York: The Engineering News Publishing Co. London: Archibald Constable & Co., Ltd. Cloth; 6 × 9¼ ins.; pp. 199; 43 illustrations in text. $2, net.

Mr. Robinson's book contains many useful suggestions on street planning in its relation to the plan of the whole city, but on finishing the book the reader feels somewhat confused. This confusion is due to an involved method of handling the subject, to many repetitions of the same idea and to a lack of clearness and conciseness.

After a brief general introduction and a chapter explaining why the street plan of a city needs to be varied in character to meet the needs of different kinds of traffic the author sets forth the objections to a single standard for all the streets of a city, regardless of their character. He next discusses street widths in relation to both housing and land values. Main traffic streets are next considered from various points of view. These topics occupy five chapters.

In Chapter VI., "How to Lessen the Cost of Wide Streets," the author takes up excess condemnation, the use of arcades, the zone system, and municipal ownership of land. This chapter is naturally followed by one on "Provision of Central Control." Here there are reviewed certain pertinent legislation in Saxony, the recent British Town Planning Act and some American commissions created in a few cities to deal with the matter.

Three chapters are devoted to both high-class residence streets and minor streets for humble homes. The final chapter deals with parks, playgrounds, open spaces, and civic centers. A brief "conclusion," an appendix and a short index close the volume. The appendix consists of extracts from a report on a uniform city-planning code, presented to the National Conference on City Planning, held at Philadelphia in 1911. The report was prepared by Mr. Andrew Wright Crawford, Assistant City Solicitor of Philadelphia.

The following comments have been suggested by a reading of the book:

The book seems to be chiefly an argument in favor of narrower streets for residential districts. As it is impossible for any one to foresee how a city will develop it is rather dangerous to plan a section only for residences. And again, even in residential districts it should be possible to have wide streets, if desired, to accommodate heavy traffic which might come or as a general protection from fire and as a space for air and breadth of scope. Streets should be laid for future uses, with only such portions worked as may be necessary for immediate use; the fee to remain with the municipality so that the remainder of the street can be utilized at a future date without purchase of expensive property. The original land cost would be small and the benefit would be shared by the entire community.

Distinction should be made between planning new town sites and remodeling old ones. This is necessary because changes as radical as many of those suggested by the author would be liable to do away with the character of an old town, although the ideas might be carried out in planning a new city. Distinctive changes in an old town might produce disastrous results, to say nothing of the expense involved.

Mr. Robinson's suggestions for following the topography where practical is a good one, but should not make the layout too complex, round about or confusing.

The author's idea of having different sizes and classes of streets to accommodate different conditions is excellent, and instead of a uniform system and of the same class of construction, which is apt to be wasteful, we should have the supply equal the demand.

It is most advisable to have parks and playgrounds, although one hardly shares the author's anxiety of there being too many. The location of parks and playgrounds in the rear of the lots would make the size of blocks unwieldly if the district should change from residence to business.

Central control is a beautiful idea, but might be fraught with the usual corrupt management, which would be untenable and tend to do away with independence. It seems impractical to set standards and make general rules for city building. Perhaps the author did not intend to have the many general suggestions taken literally or cover specific cases.

The great difference between the development of the growing city on the line of activity with great transit facilities, and the town which is side-tracked and has little hope for rapid growth, should be kept in mind when reading this book. In other words, town planning and street widths, like any other engineering or landscape problems, are subjects for careful and special study rather than for general rules.

The arrangement of residence sections in close proximity to working districts is a most practical suggestion. The plan would relieve transit lines and would be true economy to the worker.

Arrangement of thoroughfares to run straight between centers or foci is of great importance. The proximity of high- and low- or middle-class residential sections seems essential for social as well as economic reasons. The author's suggestion to divide up the thoroughfares into sections, each for one particular class of traffic, is excellent.

The idea of having numerous centers in a city seems much better than to try and concentrate about one center. The author's plan of improving only the necessary width of streets to suit the demand is splendid, provided there is room to grow with the demand.

The suggested improvements should not be carried out in so radical a way as to endanger the old landmarks and characteristics of a place by which we know the town or city. Additions to rather than plan changes should be made where possible. The suggested two-level streets are most practical in certain locations and should be availed of.

Many of the quotations given in the book are interesting and some practical; most of them have been tried with results varying with the city where they have been tried. Few have been universally successful.

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Railway Regulation.

PROBLEMS IN RAILWAY REGULATION.—By Henry S. Haines, M. Am. Soc. C. E.; M. Am. Soc. M. E.; formerly Vice-President and General Manager "Plant System" of Railroad and Steamship Lines; also Commissioner Southern States Freight Association; ex-President American Railway Association; author of "American Railway Management," "Restrictive Railway Legislation," and "Railway Corporatons as Public Servants." New York: The Macmillan Co. Cloth; 5¼ × 8 ins.; pp. 582. $1.75, net.

The author of this book is well known to American engineers, at least of the older generation and has already made valuable contributions to the literature of railway economics, as noted above. In the present volume the author devotes a hundred odd pages to a historical review of railway development in the United States, and of the growth of railway regulation by State and Federal governments. The succeeding chapters are devoted separately to problems in Finance, Construction, Operation, Traffic, Discrimination, Rate Making, Capital and Labor, with a final chapter on "The Tendency of Government Regulation."

Col. Haines accepts without question Government regulation as inevitable and, indeed, necessary. He indicates his opinion, however, that the present tendency is toward too much regulation, and he emphasizes the idea that in the public interest as well as in justice to the holders of railway stocks and bonds, the mistake be not made of reducing railway profits to a point where the new capital required for railway development will have to be purchased at a high interest rate.

The book deserves the careful study of all public service commissions, legislators and others interested in finding a fair solution to the problems of railway regulation. Col. Haines writes with a technical knowledge and experience such as very few writers on an economic [illegible] ject possess. He deserves credit for devoting [illegible]s leisure since his retirement from the active [illegible]ctice of his profession to the preparation of [illegible]udies of the sort represented by this book. [illegible]s a case where the technical knowledge of [illegible] engineer and the man of large experience can [illegible] of great value in indicating the wise course [illegible]follow in dealing with public problems whose [illegible]rms are little understood by the average man.

HANDBOOK OF STEAM SHOVEL WO[illegible].—A Report by the Construction Service [illegible] to the Bucyrus Co. South Milwaukee, [illegible]s.; The Bucyrus Co. Cloth; 4 × 7 ins.; pp. [illegible]; 88 text illustrations. $1.50, net.

This book has been issued by the Bu[illegible]rus Company as an aid to the users of their s[illegible]am shovels both in estimating the cost of proposed work and in checking up on the cost of work under way. It comprises 45 most thorough time studies of the operation of various typical shovels working in typical materials, from which studies a series of estimating curves suitable for any and all conditions have been prepared. The book is a good example of the application of scientific methods to modern contracting.

THE COPPER HANDBOOK.—A Manual of the Copper Industry of the World. Vol. X. Compiled and published by Horace J. Stevens, Houghton, Mich. Cloth; 6 × 9 ins.; pp. 1,902. $5, net.

Again we have a new edition of Mr. Stevens' unique work. It needs only a glance to show the enormous amount of labor needed to keep this manual up to date and authentic. Small wonder that the regularity of revision is interrupted (for which the compiler apologizes); the wonder is that the author can afford, from the returns of such a book, any organization at all for adequate revision. As in previous issues, the compiler's individuality crops out at innumerable points—always increasing the interest by enlivening otherwise dry reports of wildcat and moribund concerns.

The familiar arrangement is held to first a history of the production of copper, then a chapter on geology, one on chemistry and mineralogy, and others on mining and milling methods, smelting, uses and deposits of the world. All this occupies scarcely 1.5% of the total number of pages, the remaining 98.5% being needed for detailed descriptions of the organizations and properties of the copper mining companies of the world—as far as they can be secured. There are about 9,000 entries in this section.

The book closes with a few pages of statistics on production, dividends, world's trade, etc.

TECHNOLOGY AND INDUSTRIAL EFFICIENCY. —A Series of Papers presented at the Congress of Technology, opened in Boston, Mass., April 10, 1911, in celebration of the Fiftieth Anniversary of the Granting of a Charter to the Massachusetts Institute of Technology. New York: McGraw-Hill Book Co. Cloth; 6¼ × 9¼ ins.; pp. 486; many text illustrations. $3, net.

To celebrate fittingly the fiftieth anniversary of the chartering of the Massachusetts Institute of Technology, a series of meetings were held last spring under institute auspices. At this "Congress" many papers were read covering a wide range of engineering activity. These papers, with a couple of exceptions, where length or informality of the remarks prevented, have now been gathered into a single volume which gives the reader a series of quarter-hour readings on scientific investigation, the relation of education to industry, administration, industrial development, public health, and architecture.

By inadvertence, the pamphlet entitled "Instructions for Experiments in Laboratory for Testing Materials, Purdue University," by Professors Hatt and Scofield, Lafayette, Ind., noticed on page 45 of our issue of Nov. 16, was described as being for gratuitous circulation. It should have been stated that the pamphlet was for sale at 75 cts. per copy. We are informed that the authors have been embarrassed by the large number of requests for the pamphlet which resulted from our notice, and gladly do what we can to relieve them from further embarrassment.

Hydraulics.

Reviewed by GARDNER S. WILLIAMS,* M. Am. Soc. C. E.

A TREATISE ON HYDRAULICS.—By Hector J. Hughes, A. B., S. B., M. Am. Soc. C. E.; Assistant Professor of Civil Engineering, Harvard University, and Arthur T. Safford, A. M., M. Am. Soc. C. E., M. Am. Soc. M. E.; Consulting Hydraulic Engineer; Lecturer on Hydraulic Engineering, Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 ins.; pp. 505; 6 plates, 177 text figures and 78 tables. $3.75, net.

The field covered by this book is the ordinary one of the textbook on hydraulics, including the subject of Water Wheels and Centrifugal Pumps. Its chief distinction from other works of a similar nature is in the abstracts and discussions of experiments which it gives, though it seems that the usefulness of the work as a textbook would have been increased had the experimental data been presented in different type from the rest of the book. The wisdom of some of the selections might be questioned, as, for instance, the inclusion of the Fairbairn formula for collapsing pressure, which though afterwards stated to be of questionable accuracy, is given the same typographic importance as the Chezy formula. Moreover, so far as the discussions are concerned, the experimental data referred to have evidently not always been examined with care. In referring to the differential gage using oil and water, the statement is made that the specific gravities of the liquids must be determined, when nothing of the sort is either necessary or desirable, but the instrument must be calibrated by direct comparison with a water column, since the attraction between oil and glass causes the oil to act in the gage as though it had an appreciably higher specific gravity than is actually the case, and coefficients determined according to the specific gravity relations may be in error anywhere from 2 to 10%, depending upon the oil used. Again, the statement is made that "Freeman's experiments on fire hose * * * appear to confirm Weisbach's theorem that resistances due to curvature increase with the sharpness of the curve," when as a matter of fact this is precisely what they did not prove, and so surprised was Mr. Freeman at the result that he carefully repeated his work before announcing the outcome. Such errors as these appearing in the digest of experimental data lead one to look askance at other statements.

Probably the best chapter in the book is that devoted to rod floats, though this material partakes of the nature of a field manual rather than of a textbook. As much cannot be said of the chapter on Current Meters, where the commendation of the so-called integrating method, in which the meter is moved continuously through the section, is entirely unwarranted and misleading; on account of the impossibility of rating the meter for such service any coincidences with floats or weir measurements will be accidental and unlikely to be repeated in a channel of different section or with water of different velocities, and the method should never be used.

From a theoretical point of view the most striking defect of the book is the lack of a demonstration of Bernoulli's theorem. Such an omission can hardly be overlooked in a work designed for a textbook, while, on the other hand, the descriptions of procedure are very well written, and hence add to its value as a working manual.

The reduction of wheel-test data after the method of the authors, does not lend itself so readily to the comparison of different conditions, as the method described by Mead in his "Water Power Engineering"; nor are the illustrations of settings particularly well chosen, and the discussion of centrifugal pumps is too limited to add much to the value of the book.

Considered as a whole, from the textbook standpoint, the treatment is not so scientific as that of Church, among American writers, and certainly not to be compared to that of Gibson. In analyses of experiments the work is not so

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reliable as Lea, but in descriptions of method of procedure in hydraulic investigations it outranks any of our modern works. The experimental data presented have been brought more nearly up to date than in any book yet published, and the last two characteristics entitle it to a place in the Hydraulician's Library.

The typography is good, the cuts are clear, though not always elegant, and the paper of a weight and texture to be highly commended, though its thickness might profitably have been reduced.

The book contains some valuable tables at the end, among them one of the discharge of weirs by the Fteley and Stearns formula, and a table of 3/2 powers from 1 to 1,000. Unfortunately, many of the pages of tables are folded.

Translation of Portions of Haeder's German Work on the Gas Engine.

Reviewed by LIONEL S. MARKS,* M. Am. Soc. M. E.

A HANDBOOK ON THE GAS ENGINE.—Comprising a Practical Treatise on Internal Combustion Engines. For the use of Engine Builders, Engineers, Mechanical Draughtsmen, Engineering Students, Users of Internal Combustion Engines, and Others. By Herman Haeder, Civil Engineer, Wiesbaden. Translated from the German and edited by W. M. Huskisson, A. M. I. E. E. New York: McGraw-Hill Book Co. London: Crosby Lockwood & Son. Cloth; 7 × 9½ ins.; pp. 317; many text illustrations and 46 tables. $5, net.

The handbooks which have been issued by Mr. Herman Haeder are intended primarily for the use of draftsmen engaged in the actual design of engines. The three volumes on the steam engine proved extremely useful in Germany; they are devoted respectively to the general and actual design of engines, to a series of detail drawings of actual engines, and to the design of valve gears. An English translation in one volume is well known to many engineers.

The handbook on the gas engine appeared in parts beginning in 1904 and was finished in 1908. The collected work is now published in German in two parts, of which the first is devoted to gas-engine design, and the second to valve gears, ignition and other special features, and to a collection of detailed drawings of gas engines and producers. There is also included in the German book the essential contents of another work on "Defects in Gas Engines" by the author. In consequence of the newness of the field and the paucity of books dealing with it, the gas engine handbook has become an essential part of the equipment of those gas engine designers who are able to read German. The English translation should extend considerably the usefulness of the book.

The translation is practically a literal translation of the first part, only, of the German work. The judgment of the translator in selecting this portion, only, is probably good. The second part is devoted mainly to valves and valve gears, but deals also with new starting devices, governors, piping, oil engines, large gas engines and producer gas plants. It would have been valuable if the translator, who is of large experience in gas-engine design, could have given the English equivalents of those parts of the German work which he has omitted. The detail drawings of German engines, it was surely wise to omit.

The tabulated dimensions of which the book is full and which are perhaps its most useful feature to the designer, are retained in metric measure but there is also added in each case an equivalent table in inches with corresponding dimensions accurate to the nearest ⅛ or 1-16-in.

The first six chapters treat of the general arrangement, of the general dimensions, and of the forces acting in gas engines of various types. A valuable addition to the original work which is presented as an appendix to one of the chapters, consists of a series of diagrams and tables worked out by Mr. H. A. Humphrey, showing the variation of turning movement and the angular deviation of the crank shaft throughout the revolution of a number of existing large gas engines.

The classification of gas engines is unusually complete; the main characteristics of the 13 most common types are described and calculated and their relative advantages from the point of view of uniformity of turning moment are brought out. The principal value of the work is however, in Chapter VII., which occupies over one-half the book and which deals with engine parts. Separate sections in this chapter are devoted to the crank shaft, the main bearings, the frame and cylinder, the piston, the connecting rod, and the fly wheel. These sections are handled with a wealth of illustration and with a degree of detail which makes them invaluable to the designer. In considering crank shafts, for example, expressions are deduced for the stresses in the five most usual arrangements of cranks, bearings and fly wheels, at six different places in each shaft, and for positions of the crank corresponding to maximum pressure on the piston, and to maximum turning moment, respectively. In addition the calculations are actually carried out fully for four different gas engines. Five examples are given of such a minor detail as the shoulder between the crank web and the main bearing, three arrangements of oil fender rings are shown, 28 illustrations are devoted to centrifugal oiling rings for crank pins, 16 to balance weights, and on the same scale throughout the book. Most of the illustrations are accompanied by complete tables of dimensions for an extended range of engine sizes. So far as the reviewer has been able to check up these dimensions they agree well with standard American practice. An appendix gives a full account of that interesting development, the Humphrey pump. The final 65 pages are devoted to numerous useful tables such as are commonly found in engineering handbooks.

Valves, valve gears, governors, ignition devices, starting devices, and many other details, are not touched upon at all. For the range that it covers, there is probably no more useful book in existence for the designer or the draftsman who is working up the details of the gas engine.

*Professor of Mechanical Engineering, Harvard University, Cambridge, Mass.

RAILWAY SHOP KINKS.—Compiled under the Direction of a Committee of the International Railway General Foremen's Association. By Roy V. Wright, Mechanical Department Editor, "Railway Age Gazette." New York, Chicago, Cleveland and London: Railway Age Gazette. Cloth; 8½ × 12 ins.; pp. 290; 803 text figures. $2, net.

This is a compilation of descriptions of special devices and methods for use in railway shops. The material has been collected from the pages of the shop section of the "Railway Age Gazette," under the direction of the Shop Kinks Committee of the International Railway General Foremen's Association. The book is arranged with 17 chapters, in each of which are collected "kinks" applying to a single department of railway shop work, for example, to the erecting shop and to oxy-acetylene welding and cutting. More than half the space is occupied by the illustrations. There are numerous halftones but these are greatly outnumbered by line cuts, many of which show working drawings of the devices described.

STANDARDIZATION RULES OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—As Approved by the Board of Directors, June 27, 1911. New York: The American Institute of Electrical Engineers (33 W. 39th St.) Cloth; 5¾ × 9 ins.; pp. 85. 25 cts., net; Paper, 10 cts., discount on quantities.

The "standardization" rules adopted at various times by the American Institute of Electrical Engineers have first defined such terms as direct, continuous and alternating currents, cycle, period, frequency, wave-form, form-factor, generator, synchronous alternator, induction, repulsion and synchronous motor, watt-hour meter, watt meter, synchronoscope, load factor, diversity factor, demand factor, power factor, etc., etc., etc., about which there is any chance of loose, ambiguous, or non-uniform use. The rules have specified what the various commercial apparatus ratings should mean and, in a general way, how the performance of a machine should be tested. The rules have laid down a schedule of average voltages to be used for commercial circuits so that the designs should permit of free interchange of apparatus and the ready supply of standard parts.

The first rules were formulated in 1898 and adopted in 1899. It was found necessary to change them in 1902, and again in 1906. The 1906 revision, however, was not immediately completed and the Standards Committee of the Institute, which had the matter in charge, was

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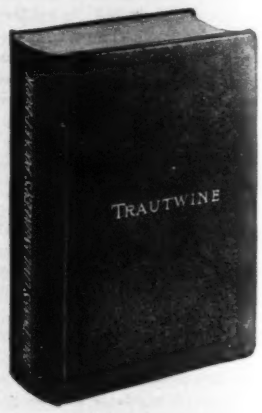

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made a standing organization. The revisions have themselves been revised and discussed in all these years until the membership seems to have been satisfied that they are in the most acceptable form possible. The new rules were adopted on June 27, 1911.

The growth of the Code is seen by comparing the number of pages in the first and the latest report—16 and 35. It is evident by the merest examination that new terms, new tests and new ratings have been brought in by the great development of alternating-current machinery and the spread of transmission lines and electric distribution networks about the country.

The Dangerous House Fly.

THE HOUSE FLY—DISEASE CARRIER.—An Account of Its Dangerous Activities and of the Means of Destroying It. By L. O. Howard, Ph. D. New York: Frederick A. Stokes Co. Cloth; 5½ x 8 ins.; pp. 312; 41 text illustrations. $1.60, net.

Long under the suspicion by the cleanly housewife, always a pest to every one, but for centuries tolerated by most people as a harmless though troublesome nuisance, the common house fly has at last been detected and branded as an enemy to human life and health. This ill repute is well deserved, but there is, nevertheless, room for honest differences of opinion as to the extent of the danger from flies under various local conditions, the degree to which the danger can be averted within practicable limits, and the best means of fighting the fly. All these and many other questions centering in the fly are discussed by Dr. Howard in the book before us, but not even his knowledge and judgment as an entomologist, combined with his wide ranging through published and unpublished sources of information, enables him to make final answers to all the questions—simply for lack of scientific observations and deductions on some points. He does, however, make it perfectly clear that the fly is a menace to health and life, and that it may be kept well in check, even if not absolutely exterminated, by measures within the mental, physical and financial capacity of most individuals and municipalities.

The book opens with an exposition of the "Zoological Position, Life History and Habits" of the domestic fly, so written, as is the whole book, as to be within the grasp of most persons of fair intelligence. Towards the end of the book there is a chapter on "Other Flies Frequenting Houses." These are quite numerous as to kinds, but few in percentage of total flies found within doors. Still another chapter dealing with the fly itself is one on its "Natural Enemies." Although these include fungi, protozoa, mites, spiders, scorpions, centipedes, both predatory and parasitic insects, and rats, the fly still persists.

Practically speaking, the most important chapters in the book are those entitled "The Carriage of Disease by Flies" and "Remedies and Preventive Measures." Naturally, in discussing the diseases spread by flies most space is given to typhoid fever. A round dozen of other diseases or affections are also reviewed in their relation to the fly as an infective agent. The most important of these are cholera, dysentery, infantile diarrhea and tuberculosis. As to remedial measures, the author, very sensibly, lays most stress on the abolition of breeding places, the chief of which are unprotected accumulations of horse manure, unsanitary privies, and human excreta promiscuously deposited about houses, and barns, yards and fields. Tests of various methods of treating horse manure for the prevention of fly breeding are recounted. Some of these appear to be effective, but as a rule they are either too expensive or too troublesome to be practicable for general use. Proper storage and frequent removal of horse manure are by all odds the best means of eliminating or reducing this great, if not the greatest, source of the fly nuisance. As to sanitary privies, the author seems to think that nothing approaches in safety the wet privy recently brought to public attention by Drs. Lumsden, Stiles and Roberts, of the U. S. Public-Health and Marine Hospital Service.

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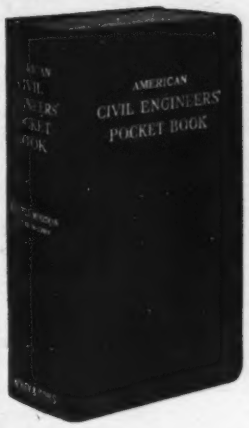

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An appendix describing this privy is inserted; also another appendix, giving specifications, drawings and bill of materials for an improved type of dry privy, also drawn from the Public Health Reports of the Service named.

Those who have unqualifiedly pronounced the garbage can as a public breeding place for house flies will do well to note Dr. Howard's statement that it is quite another kind of fly, one which is not a frequent house visitor, which breeds freely in garbage; also that since it takes from 8 to 14 days (depending on climatic conditions) for flies to develop, full-fledged, from the egg, the house fly could not multiply in garbage cans, under any regular system of collection.

The author advises that fly extermination begin early in the season, by making use of traps to catch the first flies, before breeding begins. He cites successful practical experience to this end, and shows several styles of traps which have been used. Since one pair of flies will produce billions of their kind in a single season (not allowing for mishaps) the advice to begin extermination measures early in the spring is well worth following.

By way of general criticism, we would suggest that the value of the book might have been increased had the author more often supplemented his review of the experiments and opinions of others by his own judicial conclusions, and had he inserted a final summary of practical conclusions.

The book is well illustrated, but author and publisher have joined in that unpardonable sin of omission by failing to include an index.

JOINT COMMITTEE ON REINFORCED CONCRETE.—Second Report: London; The Royal Institute of British Architects (9 Conduit St., Regent St., W.) Boards; 6 × 9¾ ins.; pp. 48; illustrated. 1s.; American price, 40 cts., net.

The British Joint Committee on Reinforced Concrete was formed some six years ago, at the instance of the Royal Institute of British Architects and contains representatives from that Institute, the Concrete Institute, the District Surveyors' Association, the Institute of Builders, the Municipal and County Engineers' Association and the various engineering branches of the government. In 1907 it issued a first report which was a satisfactory resumé of the then rapidly changing art of concrete design, but this report has by now become quite out of date and in need of revision. Such revision has been made in this Second Report, which is now before us. It is, we presume, a fair statement of the conservative British view of concrete design, but from numerous published criticisms we would judge that it suffers the same attacks from the advanced British concrete users as does the American Joint Committee report from many of our busiest concrete contractors. At least, the follower of this British code will be safe, which is a prospect not utterly to be despised, even though his costs may run somewhat higher and his details be somewhat more complicated than those of his more venturesome and confident brother. Certainly, the new British report adds nothing to American knowledge.

This Committee Report should not be confused with the Preliminary Report of the Committee on Reinforced Concrete of the Institution of Civil Engineers, which we reviewed in this Supplement of Oct. 13, 1910.

PUNJAB RIVERS AND WORKS.—A Description of the Shifting Rivers of the Punjab Plains and of the Works on Them, namely, Inundation Canals, Flood Embankments and River Training Works, with the Principles for Designing and Working Them. By E. S. Bellasis, M. Inst. C. E.; Late Superintending Engineer, Punjab Irrigation. Author of "Hydraulics with Working Tables." London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 8¼ × 13½ ins.; pp. 65; 11 plates. $3.50 net.

In no section of the world has the science of irrigation engineering or of flood control been so long practiced as in that northern portion of the Indian peninsula known as the Punjab. Here for many centuries the local engineers have been building irrigation canals, taking water from the flooded rivers, and flood embankments to retain the rising rivers within their banks. The problems which have been presented are in a way peculiar to the locality, but in general they are the same as found the world over where rivers run in alluvial country and are subject to sudden and high rises. For that reason a description of the methods practiced in the Punjab is of interest to all engineers concerned with river control or with irrigation work. Mr. Bellasis has been for many years an engineer on this work and his book has the merit of authoritative source.

DIE GRUNDLAGEN DER ANGEWANDTEN GEOMETRIE.—Eine Untersuchung über den Zusammenhang zwischen Theorie und Erfahrung in den exakten Wissenschaften. Von Dr. Hugo Dingler. Leipzig: Akademische Verlagsgesellschaft m. b. H. Paper; 5¾ × 9 ins.; pp. 144. 5 marks; American price, $2, net.

The author makes a commendable attempt at breaking away from the Kantian spirit of abstractness in considering the system of geometry. He seeks out the underlying empirical procedures; in effect he traces the basal definitions and axioms back to the drawingboard and the straight-edge. Of course the tendency of the work is essentially philosophical, but this may make it interesting to some technical men.

MASCHINEN-TECHNISCHES LEXIKON.—Herausgegeben von Ing. Felix Kagerer. Parts 2 to 7. Wien: Verlag der Druckerei-und Verlags-Aktiengesellschaft, vorm. R. v. Waldheim, Jos. Eberle & Co. Paper; 7 × 10½ ins.; pp. 240; illustrated. Price per part, 80 h. = 70 pf. = 95 cts.

This cyclopedia of mechanical engineering will consist of about 1,000 pages, when completed. It appears in 30 consecutive pamphlets, of which the first was noted in our issue of June 15, 1911. Six further pamphlets are now at hand, carrying the alphabet along to "Doppelsitzventile." As already noted for the first pamphlet, the treatment is intermediate between that of a dictionary and that of a cyclopedia. The text is quite fully illustrated with drawings and halftone cuts.

A new map of North America, printed in 42 colors, has been published by the United States Geological Survey. The printing was done on four sheets, which have been so fitted together and mounted as to make a map 5 ft. wide by 6 ft. 5 ins. high. The scale is put to 5,000,000, or 80 miles to the inch. Each of the 42 colors represents a division of rock strata. The map is sold at the nominal price of 75 cts. a copy.

Publications Received.

DIE BAUMASCHINEN.—Being Part IV. of "Handbuch der Ingenieur-wissenschaften." Bearbeitet von A. Steuer and L. v. Roessler. Herausgegeben von F. Lincke, Geheimer Baurat, Professor i. P. in Darmstadt. Second edition, revised and enlarged. Leipzig: Wilhelm Engelmann. Paper; 7½ × 11 ins.; pp. 198; 72 text illustrations.

BERECHNUNG EBENER, RECHTECKIGER PLATTEN MITTELS TRIGONOMETRISCHER REIHEN.—By Karl Hager, Professor an der Techn. Hochschule, München. München und Berlin: Druck und Verlag von R. Oldenbourg. Paper; 7¾ × 11 ins.; pp. 94; 36 text illustrations. Marks, 7.20; American price, $2.90, net.

DER BRUECKENBAU.—Lehr- und Nachschlagebuch für Studierende und Praktiker. By M. Strukel, Professor an der Finnländ. Technischen Hochschule in Helsingfors. I. Teil. Enthaltend: Allgemeines, Statik der Brückenträger, Erddruck, feste Hölzerne und Eiserne Brücken. Leipzig: A. Twietmeyer. Paper; 7½ × 10½ ins.; pp. 517; 521 text illustrations and 43 plates. Marks 18; American price, $7.20, net.

BULLETINS, UNITED STATES GEOLOGICAL SURVEY.—Geo. Otis Smith, Director. Washington, D. C.: Pub. Docs. Paper; 6 × 9 ins.

No. 484: The Granites of Connecticut. By T. Nelson Dale and Herbert E. Gregory. Prepared in cooperation with the Geological and Natural History Survey of Connecticut. Pp. 137; 7 plates (one map), 12 text figures.

No. 490: Mineralogical Notes, Series 1. By Waldemar T. Schaller. Pp. 109; 14 text figures.

No. 491: The Data of Geochemistry. By Frank Wigglesworth Clarke. Second edition. Pp. 782.

No. 493: Results of Spirit Leveling in Illinois, 1909 and 1910. R. B. Marshall, Chief Geographer. Work done in cooperation with the State of Illinois. Pp. 115; one plate.

No. 495: Bibliography of North American Geology for 1910, with subject index. By John M. Nickles. Pp. 179.

COMMISSION GOVERNMENT IN AMERICAN CITIES.—The Annals (American Academy of Political and Social Science), Vol. XXXVIII., No. 3, November, 1911; Emory R. Johnson, Editor. (Issued bi-monthly.) Philadelphia, Pa.: American Academy of Political and Social Science. London: P. S. King & Son, 2 Great Smith St., Westminster. Paper; 6½ × 9¾ ins.; pp. 311. Per year, $6; per number, $1.

THE CORROSION OF IRON AND STEEL.—By J. Newton Friend, Ph.D. (Wurz.), [illegible] (B'ham); Fellow of the Chemical Society; Member of the Iron and Steel Institute; Author of "The Theory of Valency," "An Introduction to the Chemistry of Paints," "Analytical Tables" London, New York, Bombay and Calcutta: Longmans, Green & Co. Cloth; [illegible] 8 ins.; pp. 300; 63 text figures. $1.80, net.

DYNAMICS OF MACHINERY.—By G[illegible]ano Lanza, S. B., C. & M. E., Engineer; Professor Emeritus of Theoretical and Applied Mechanics, Massachusetts Institute of Technology. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 246; 137 text illustrations. $2.50, net (10[illegible] net).

THE ECONOMICS OF CONTRACTING.—A Treatise for Contractors, Engineers, Superintendents and Foremen Engaged in Engineering Contracting Work. By Daniel J. [illegible]auer, Construction Economist; Eastern Editor of "The Contractor." Chicago, Ill.: E. H. [illegible]ungartner, Monadnock Block. Cloth; 5½ × [illegible] ins.; pp. 269; 10 illustrations in text. $2.50, net.

DAS EISENHUETTENWESEN.—Eine Uebersicht seiner Entwicklung sowie seiner kulturellen und wirtschaftlichen Bedeutung. By H. Jüptner v. Jonstorff, o. ö. Professor an der Kais. Königl. Techn. Hochschule in Wien. Leipzig: Akademische Verlagsgesellschaft m. b. H. Paper; 6 × 9¼ ins.; pp. 212; 123 text illustrations.

ELEMENTARY APPLIED MECHANICS.—By Arthur Morley, M. Sc., M. I. Mech. E., Professor of Mechanical Engineering in University College, Nottingham, and William Inchley, B. Sc., A. M. I. Mech. E., Lecturer and Demonstrator in Engineering in University College, Nottingham. London, New York, Bombay and Calcutta: Longmans, Green & Co. Cloth; 5 × 7½ ins.; pp. 382; 261 text figures. $1, net.

EXPERIMENTAL ENGINEERING AND MANUAL FOR TESTING.—For Engineers and for Students in Engineering Laboratories. By Rolla C. Carpenter, M. S., C. E., M. M. E., and Herman Diederichs, M. E., Professors of Experimental Engineering in Cornell University. Seventh edition, rewritten and enlarged. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 1,132; 636 figures in text. $6, net.

EXPERIMENTS UPON THE PURIFICATION OF SEWAGE AND WATER AT THE LAWRENCE EXPERIMENT STATION.—By H. W. Clark and Stephen De M. Gage. [Year ending Nov. 30, 1910.] Reprinted from the 42nd Annual Report of the State Board of Health of Massachusetts. Boston, Mass.: Pub. Doc. Paper; 6 × 9 ins.; pp. 52.

HOW ARE YOUR TAXES SPENT?—Report on Expenditures of the Department of Charities. Pittsburgh, Pa.: Pittsburgh Civic Commission, 324 Fourth Ave. Paper; 6 × 9 ins.; pp. 14; illustrated.

THE INDUCTION MOTOR.—By Benj. F. Bailey, B. S. Ph. D., Junior Professor of Electrical Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 225; 120 text figures. $2.50, net.

INDUSTRIAL DEPRESSIONS.—Their Causes Analysed and Classified with a Practical Remedy for Such as Result from Industrial Derangements. Or, IRON THE BAROMETER OF TRADE. By Geo. H. Hull. New York: Frederick A. Stokes Co. Cloth; 6 × 9 ins.; pp. 287; two folding charts. $2.75, net.

INSPECTION OF THE MATERIALS AND WORKMANSHIP EMPLOYED IN CONSTRUCTION.—A Reference Book for the Use of Inspectors, Superintendents, and Others Engaged in the Construction of Public and Private Works. Containing a Collection of Memoranda Pertaining to the Duty of Inspectors; Quality and Defects of Materials; Requisites for Good Construction; Methods of Slighting Work; Etc., Etc. By Austin T. Byrne, Civil Engineer; Author of "Highway Construction." Third edition, thoroughly revised. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 4¼ × 7¼ ins.; pp. 609. $3, net.

INSTITUTION OF MINING AND METALLURGY.—Transactions of the 20th Session, 1910-1911; Vol. XX. Edited by Arthur C. Claudet, S. Herbert Cox and William Gowland (Honorary Technical Editors), and C. McDermid (Secretary). London: E. & F. N. Spon, Ltd., 57 Haymarket, and The Institution of Mining and Metallurgy, Salisbury House, E. C. New York: The Engineering and Mining Journal. Paper; 5½ × 8½ ins.; pp. 572; 83 text illustrations.

KLEINE WASSERKRAFT-ELEKTRIZITAETSWERKE, BESONDERS DEREN SELBSTTAETIGE REGULIERUNGSARTEN.—Ing. C. Reindl, Landshut. Sonderabdruck aus "Zeitschrift für das gesamte Turbinenwesen." 1911, Heft 10-24. Münich and Berlin: R. Oldenbourg. Paper; 9½ × 12½ ins.; pp. 48; 70 text illustrations. Marks 3; American price, $1.20, net.

LABOR BULLETINS, THE COMMONWEALTH OF MASSACHUSETTS.—Bureau of Statistics; Charles F. Gettemy, Director. Boston, Mass.: Pub. Docs. Paper; 6 × 9½ ins.

No. 83: Directory of Labor Organizations in Massachusetts, 1911. Pp. 39.

No. 84: Labor Legislation in Massachusetts, 1911. With Text of Legislation for 1910. Pp. 128.

No. 85: Quarterly Report on the State of Employment, Sept. 30, 1911. Pp. 8.

LEGISLATIVE REFERENCE LISTS, 1912.—Virginia State Library. Compiled by Earl G. Swem, Assistant State Librarian. Richmond, Va.: Pub. Doc. Paper; 6 × 9 ins.; pp. 70.

METALLURGY.—Volume I: Introductory. By Herbert Lang, Author of "Matte Smelting." New York and London: McGraw-Hill Book Co. Cloth; 6¼ × 9½ ins.; pp. 255; 24 text illustrations. $3, net.

MICROBIOLOGY.—For Agricultural and Domestic Science Students. Edited by Charles E. Marshall, East Lansing, Mich., Professor of Bac-

teriology and Hygiene, Michigan Agricultural College, Philadelphia, Pa.: P. Blackiston's Son & Co. Cloth; 5 × 8 ins.; pp. 724; 128 illustrations. $2.50, net.

THE MINERAL INDUSTRY OF NEW JERSEY FOR 1910.—By Henry B. Kümmel and S. Percy Jones. Bulletin No. 5, Geological Survey of New Jersey; Henry B. Kümmel, State Geologist. Trenton, N. J.: Pub. Doc. Paper; 6 × 9 ins.; pp. 24.

MINING WITHOUT TIMBER.—By Robert Bruce Brinsmade, B. S., E. M., Formerly Professor of Mining Engineering at West Virginia University; Mem. Am. Inst. M. E., Coal Mining Inst. of Am., Soc. Prom. Eng. Ed., etc. New York and London: McGraw-Hill Book Co. Cloth; 6 × 9½ ins.; pp. 309; 146 text figures. $3, net.

MITTEILUNGEN AUS DEM KOENIGLICHEN MATERIALPRUEFUNGSAMT ZU GROSS-LICHTERFELDE WEST.—Herausgegeben im Auftrage der Königlichen Aufsichts-Kommission. Parts V and VI. Berlin; Julius Springer. Paper; 7½ × 10½ ins.; pp. 360; illustrated. Price per year, 16 marks; American price, $6.40, net.

MODERN PRACTICE IN MINING.—Vol. IV.: The Ventilation of Mines. By R. A. S. Redmayne, M. Sc., M. Inst. C. E., M. Inst. M. E., M. Inst. M. and M., F. G. S.; His Majesty's Chief Inspector of Mines; Late Professor of Mining in the University of Birmingham; Certificated Colliery Manager, Etc. London, New York, Bombay and Calcutta: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 231; 2 folding plans, 107 text illustrations and 21 tables. 6/6, net.

NATIONAL ASSOCIATION OF CEMENT USERS.—Proceedings of the Seventh Annual Convention, Held at New York, N. Y., Dec. 12-20, 1910. Vol. VII. Edited by the President (Richard L. Humphrey). Philadelphia, Pa.: The Association (E. E. Krauss, Secy.) Cloth; 6 × 9¼ ins.; pp. 920; many text illustrations.

NAVAL ARCHITECTURE.—By Cecil H. Peabody, Professor of Naval Architecture and Marine Engineering, Massachusetts Institute of Technology. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 641; 218 text illustrations. $7.50, net (31/-net).

THE OFFICIAL BOOK OF NEW SOUTH WALES, 1909-10.—John B. Trivett, F. R. A. S., F. S. S., Government Statistican. Sydney, N. S. W.: Pub. Doc. Boards; 6 × 10 ins.; pp. 634; one map.

OHIO COOPERATIVE TOPOGRAPHIC SURVEY.—Progress Report to January 1, 1910. By C. E. Sherman, Inspector. Columbus, Ohio: Secretary of State. Cloth; 6½ × 9¾ ins.; pp. 633; three folding maps (two in pocket). Postage, 26 cts.

OHIO ELECTRIC LIGHT ASSOCIATION.—Proceedings of the 17th Annual Convention held at Cedar Point, L. E. Ohio, July 25-28, 1911. Greenville, Ohio: D. L. Gaskill, Secy. Cloth; 6½ × 9 ins.; pp. 182; illustrated.

PLANE SURVEYING.—A Text and Reference Book for the Use of Students in Engineering and for Engineers Generally. By Paul C. Nugent, A. M., C. E., Professor of Civil Engineering, Syracuse University; M. Am. Soc. C. E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 × 9¾ ins.; pp. 599; 8 plates, 327 text illustrations, 19 tables and 6 calculation forms. $3.50, net (15/-net).

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